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A SUMMARY OF CURRENT RESEARCHES RELATING TO
ZOOLOGY, BOTANY AND MICROSCOPY,
NOTICES OF NEW BOOKS,
AND THE
PROCEEDINGS OF THE SOCIETY.

ERRATA NOTICES.

"On the Theory of the Reflecting Condenser for Dark-Field Illumination," by Henry F. W. Siedentopf, D.Ph., D.Eng. (Journ. Roy. Micr. Soc., Series III, Vol. XLIX, Part 4, December 1929, pp. 349-358).

Page 349, line 15, *read* Gehlhoff instead of Gehhoff.

„ 353, formula 23, *read* $\phi = 0$ „ „ $\phi = a$.

„ „ „ „ „ $u_{(e=0)}$ „ „ $w_{(e=x)}$.

„ 356, „ 26, „ z instead of 2.

„ 357, line 4, *read* $\zeta = \frac{z}{r_1}$ „ „ $\frac{z}{r_1}$.

„ 358, References, *read* Eppenstein instead of Eppstein.

„ „ „ „ Gehlhoff instead of Gehhoff.

"A Technique for the Microscopical Examination of Wool Fibres," by Robert Burgess, M.Sc., and Claude Rimington, M.A., Ph.D. (Journ. Roy. Micr. Soc., Series III, Vol. XLIX, Part 4, December 1929, pp. 341-348), page 342, 4th line should *read*: "Five cc. of 8 p.c. sodium nitrite solution is added to 10 cc. of 10 p.c. sodium sulphanilate..."

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MARCH, 1929.

TRANSACTIONS OF THE SOCIETY.

I.—LATER STAGES IN THE SPERMATOGENESIS OF
LEPISMA DOMESTICA, WITH A NOTE ON ITS VACUOLAR
SYSTEM.

By R. N. MUKERJI, M.Sc., D.I.C.

(From the University Zoological Dept., Trinity College, Dublin.)

(Communicated by J. BRONTÉ GATENBY.)

THREE PLATES AND ONE TEXT-FIGURE.

IN a previous paper on the spermatogenesis of *Lepisma domestica*, by Gatenby and Mukerji (1929), it was pointed out that Bowen's interpretation of the subject was rather incorrect, and that the account of Charlton (1921) was more in conformity with the description given by us than that of Bowen (1924). The latter author did not seem to realise that the spermatogenesis of *Lepisma* could be compared with the same process as found in some other insects such as a Lepidopteron or a Cicindelid. Instead of trying to bring this *Lepisma* spermatogenesis in line with these insects, he went so far as to suggest that the sperm of *Lepisma* is of an atypical type, differing in every respect from all other typical flagellate sperms and partly comparable to the sperm of *Ascaris* in so far as the position of the acrosome is concerned. In a previous paper (Gatenby and Mukerji (1929)) it has already been pointed out that what Bowen calls the acrosome in *Lepisma* is not the acrosome, but a body (post-nuclear body) as yet undescribed by all authors except Gatenby (1922 and 1929), who noted its

presence in every type of spermatogenesis studied by him. In the case of *Lepisma* this body has been referred to by Charlton (1921) as the middle-piece.

Bowen (1924), while speaking of the acrosome (really the post-nuclear body) in *Lepisma*, says that "the term acrosome is here applied to the

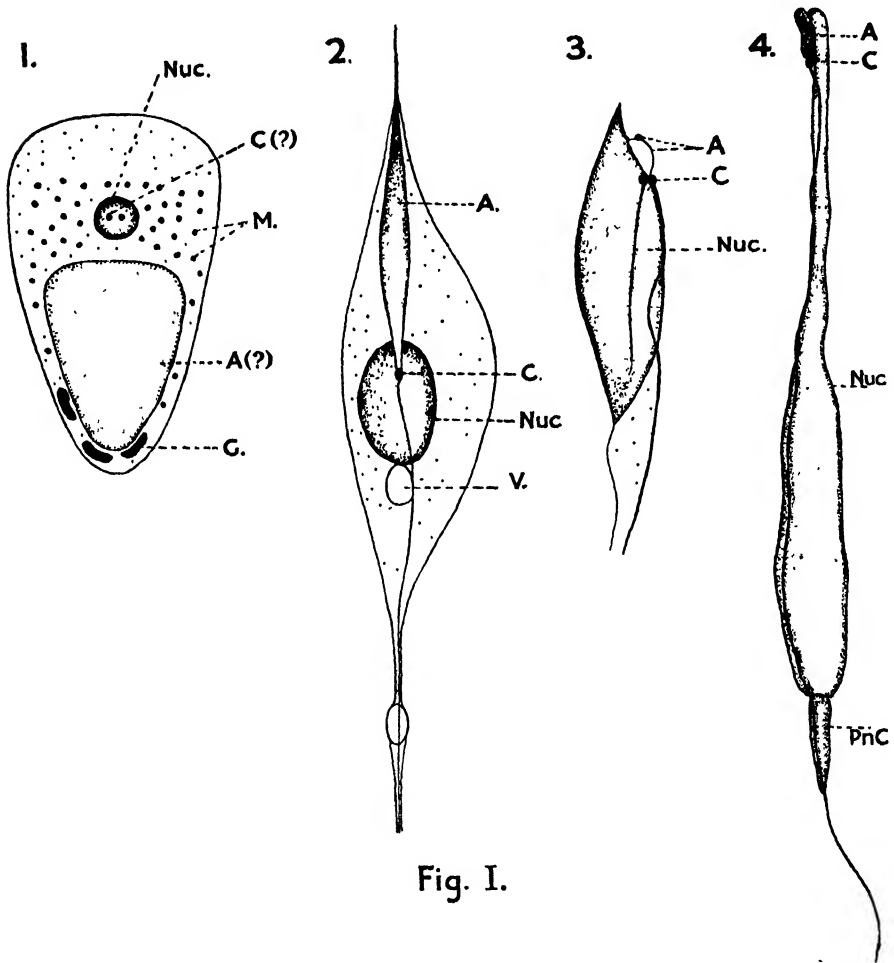


Fig. I.

1. Diagrammatic representation of the sperm of *Ascaris* (Bowen (1925)).

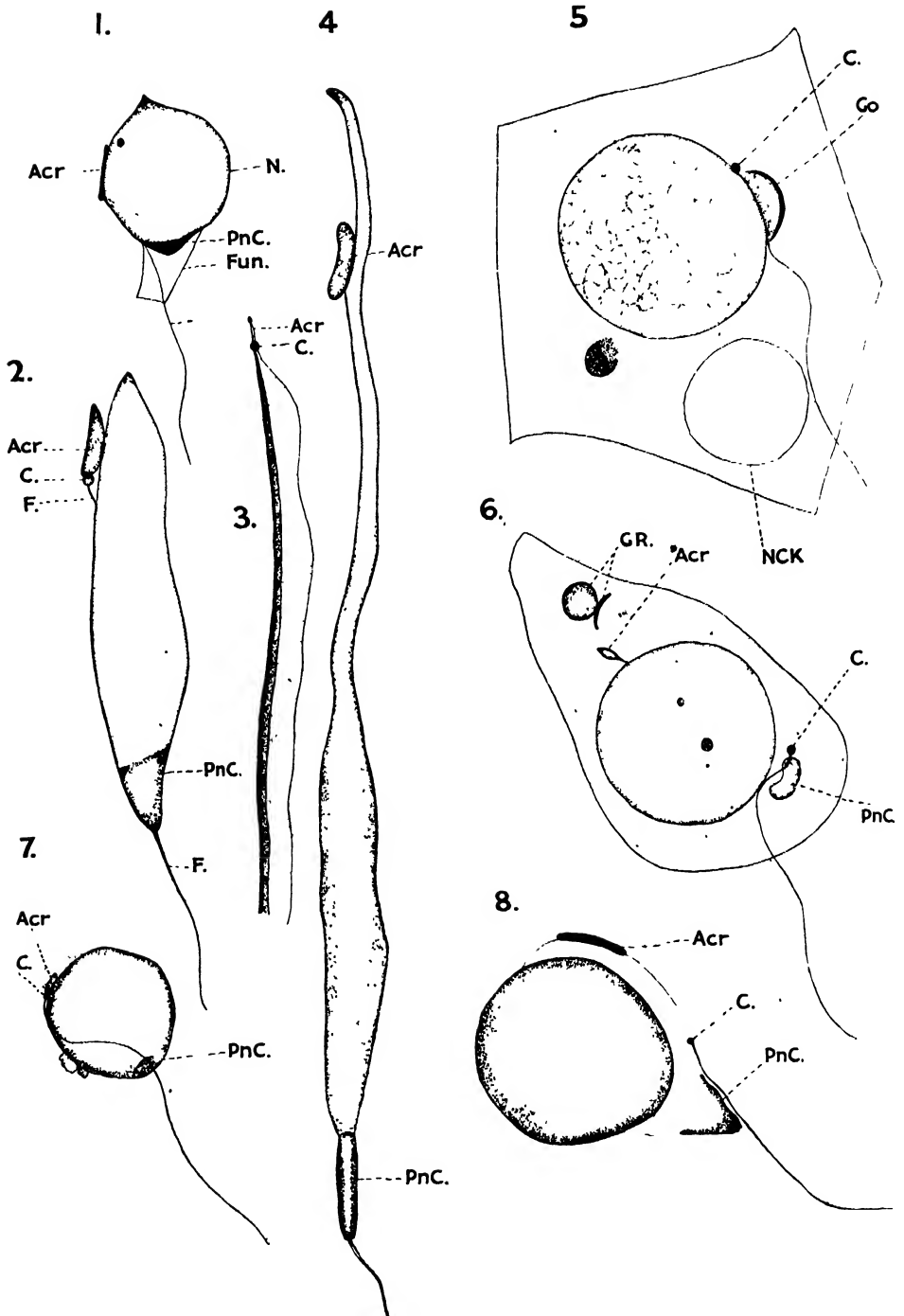
2. Developing sperm of *Pygæra* (after Bowen (1922)).

3. Developing sperm of *Cicindella sex-guttata* (after Bowen (1924')).

4. Developing sperm of *Lepisma domestica*.

A, acrosome; C, centrosome; G, Golgi body; M, mitochondria; PnC, post-nuclear body; V, mitochondrial vesicle.

material contributed to the sperm by the Golgi apparatus plus idiosome"; but, as he himself admits, he has not been able to follow the actual steps in its deposition from the Golgi-idiosome complex. In fact, this wrong assumption of its being the derivative of the Golgi apparatus has led Bowen



to compare this body with the similarly situated refringent body (= acrosome ?) in *Ascaris* (text-fig 1), and to regard the spermatogenesis of *Lepisma* as of an atypical flagellate type (considering the position of the acrosome and the centrosome). Truly speaking, the sperm of *Lepisma* is no more of an atypical type than the sperm of the other insects mentioned above, for in the case of the former much the same disposition of the sperm parts occurs as in these latter (text-figs. 1, 2, 3, 4). In each of these figures it will be seen that the centrosome is in relation with the acrosome. Further stages in their comparison will be dealt with in the following text.

Here I may add that while Charlton has made a mistake in regarding the acrosome as centrosomic in origin, he has nevertheless followed the post-nuclear body (his middle-piece) from the very earliest stage right up to the elongating sperm.

I wish here to express my thanks to Professor Gatenby for his help.

TECHNIQUE.

In the study of the spermatogenesis of this insect, the usual fixatives containing osmic acid were tried, but Flemming's solution without acetic was found to give the best result. Champy was not very successful, for it induced shrinkage of the cells. Bouin and Petrunkewitsch were useful for certain purposes, and much valuable help was obtained from the smears of testes studied both intra-vitally as well as after fixation with osmic vapour and Flemming without acetic. Such fixed smears were then stained in iron-hæmatoxylin, which was found most suitable for the purpose. Petrunkewitsch and Bouin were not found to preserve the real structure of a ripe sperm, though they had their special uses. For intra-vital staining Ringer neutral red was used, which only stained the vacuoles red, leaving the other cell elements unstained. By means of this latter method, the post-nuclear body as well as the acrosome could very well be seen in fairly advanced stages of metamorphosis.

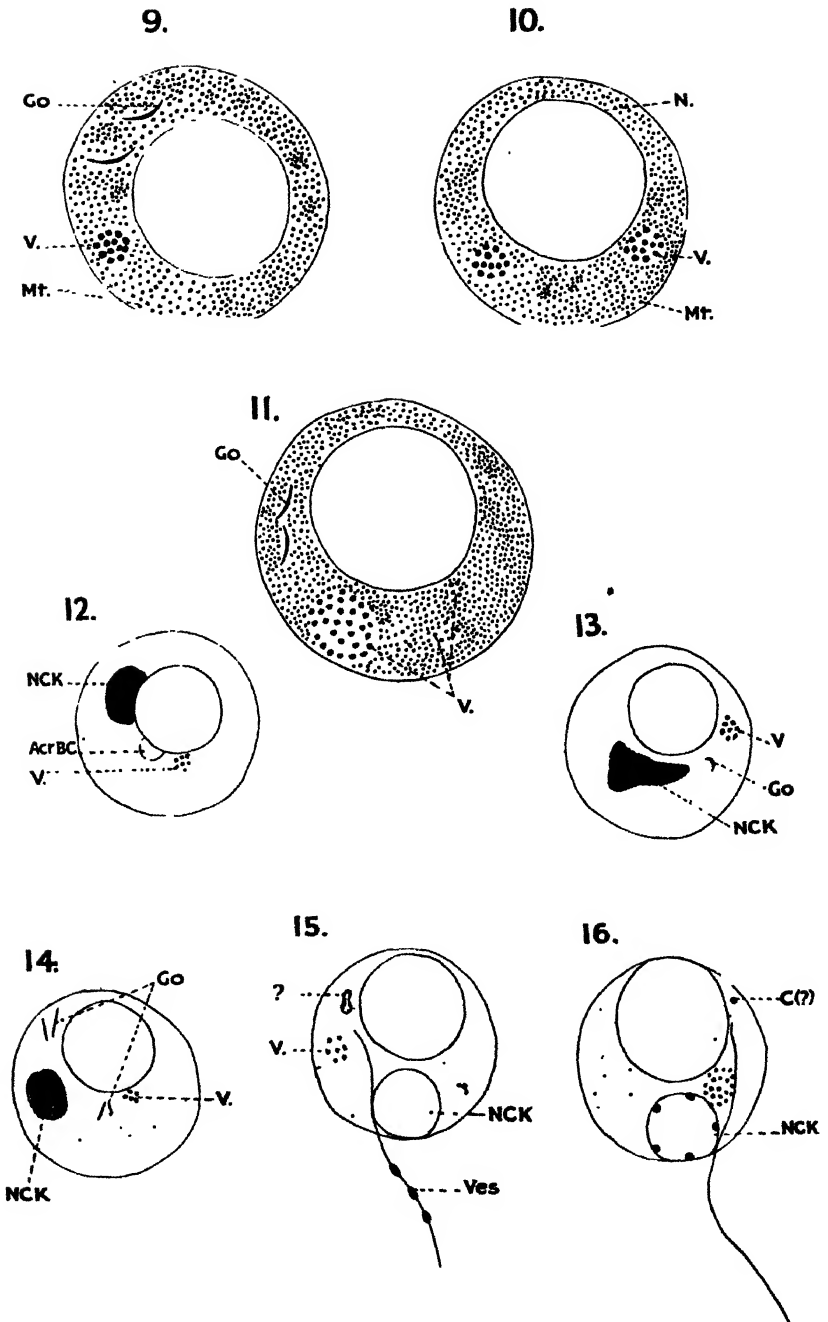
OBSERVATIONS.

In this section only the later stages of spermatogenesis in *Lepisma* will be dealt with, without any reference to the vacuolar system, which will be treated in a separate section.

Previously it has been pointed out that the disposition of the various sperm parts or structures in *Lepisma* is much the same as in *Pygæra* (Bowen (1922)), and the *Cicindela* (Bowen (1924) and Goldsmith (1919)). The centrosome in all these cases (see text-fig.) lies immediately behind the acrosome, though Bowen, in the case of *Pygæra*, is doubtful on this point, even though he has figured (Bowen, pl. 25, figs. 31-39) a darkly staining body at the point of attachment of the elongating acrosome with the

nucleus. As he has not been able to say definitely what this structure represents—either a differentiation product of the acrosome or the centrosome—I shall regard it as the centrosome itself. Conditions such as those found in *Cicindela* and *Lepisma* support this view, and especially so when the tail filament is seen to arise from it.

In plate I, fig. 5, the cell depicted is a spermatid where the parts have not as yet taken their respective positions. Nevertheless, the Golgi apparatus and the tail filament are quite clear, and the centrosome appears as a granule at the top of this apparatus. Below is the *nebenkern* (NCK), and on the left of the nucleus is a body the exact nature of which I am unable to state definitely. Fig. 6 represents an advanced stage where the cell has already elongated. The spindle-shaped acrosome is seen to lie at the top of the nucleus, while the Golgi remnant hovers near. The post-nuclear body and the centrosome are quite distinct as well. Now, coming to the next stage (fig. 1), the post-nuclear body is seen shaded black. The acrosome is attached at the side of the nucleus, and is trying to take its position at its anterior end. The peculiar funnel-shaped structure, already referred to in a previous paper, is clearly visible behind the post-nuclear body. The centrosome in this case is hard to find, but it seems that the slightly enlarged posterior end of the acrosome represents this element. In fig. 7 almost the same condition is again observed. Both in this figure and the fig. 1 the mitochondrial *nebenkern* is not visible as such, for it has already spread out along the filament to form the tail-sheath. In fig. 8 the post-nuclear body gets much enlarged, and the centrosome is seen to lie midway between this structure and the acrosome. Further stages in the process of spermatogenesis are represented by the figs. 2, 3, and 4. Fig. 2 is from a Bouin preparation. The post-nuclear body in this case has formed into a sort of cup at the base of the elongating nucleus. The acrosome, which is at this stage boat-shaped, abuts on the surface of the nucleus, and the centrosome with its attached filament appears as if carrying the acrosome on its back towards the tip of the nucleus. Fig. 4 is a Petrunkevitch preparation. Here the post-nuclear body has elongated, and the centrosome becomes indistinguishable from the acrosome. During the stages that follow, preceding the formation of a mature sperm, the acrosome gradually travels forward till it reaches the extreme tip of the elongating nucleus and there forms a slender thread-like structure—the acrosome of the mature sperm. While this differentiation is going on, the centrosome, which stains rather deeply, again becomes visible for a time at the base of the acrosome (fig. 3, and compare Bowen's fig. on *Pygæra*, pl. 25, figs. 31–39). In fact, at this stage two distinct granules are seen at the tip of the developing sperm lying close to each other. While the anterior of these two granules forms the acrosome, the posterior one persists as the centrosome, and the filament is seen to be attached to it. Smears of testes were of invaluable help in elucidating this part of the history, and though Charlton has figured a ripe spermatozoon



(Charlton's text-fig.), he has not been able to follow the final differentiation of the acrosome in the mature sperm. The slender thread in his fig. 95, at the anterior end of the sperm-head, is the acrosome. The thread or the axial filament is found to terminate at the base of this structure. Charlton figures the acrosome as a continuation of the axial filament, which is not the case, for they are two different structures retaining their individual identity even to the very last stage of spermateleosis. This can easily be made out by the difference in their staining capacity.

THE VACUOLAR SYSTEM OF PARAT.

It is only very recently that some workers have applied themselves to the study of the so-called vacuolar system in germ-cells, the exact nature, origin, and function of which are as yet unknown. The existence of such a system was first pointed out by Parat (1924) and was corroborated by workers such as Voinov (1927), Hirschler (1928), Monné (1927), Karpova (1925), and a few other workers in America. More recently it has been studied by Gatenby (1929) on *Cavia*, *Abraxas* and *Helix*. Curiously enough, Gatenby (1922), though he observed these vacuoles in fixed and stained preparations of the testes of *Saccocirrus*, some years before Parat put forward his vacuome hypothesis, could not definitely point out that such vacuoles were of universal occurrence in all kinds of germ-cells. The reason for this lies in the incapability of the vacuoles to take up the stain after chrome-osmium fixation, thus making them difficult to observe. In the case of *Lepisma*, however, as probably in all other insects, the vacuoles, like those in *Saccocirrus*, stain very lightly after fixation, and can readily be made out if one knows their appearance in a living cell stained *intra vitam* with Ringer neutral red. At the present moment this system has only been described in a very few insects, such as *Notonecta* (Voinov (1927)), *Abraxas* (Gatenby (1929)), and *Macrothylacia* (Hirschler (1927)). It has not as yet been studied in any other insect of which the spermatogenesis is known. In the case of *Lepisma* this system is very easy to follow, owing to the very large size of the cells, where all other cell elements are clearly defined and distinct—a point of great importance when one seeks to find out the exact relationship of a definite body with any other recognised structure of the cell. Unfortunately, however, in *Lepisma* the earlier stages of spermatogenesis could not be found; as a consequence, the study of this system during those stages was missed altogether.

In this account my observations on the vacuolar system begin with the spermatocyte stages and end with the elongating spermatid; but, unfortunately, its behaviour during the mitosis of the cells could not be studied, as suitable specimens were not obtained.

OBSERVATIONS.

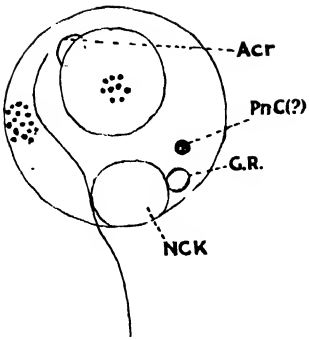
In plate II, figs. 9, 10 and 11 represent the three spermatocytes where the vacuoles appear as red vesicles. In the first and the last figures the Golgi bodies are quite distinct, but in the second they were not clearly seen. Fig. 10 is interesting because of the presence of two vacuolar systems of equal size—one on either side of the nucleus. Figs. 12–22 are the spermatids in their various stages of metamorphosis. The vacuoles are found to become differently situated at different stages of spermatogenesis, but during the deposition of the acrosome the system is found either very near the Golgi body or stuck against the wall of the nucleus. Here fig. 18 is again interesting, for it has got two systems, one on either side of the nebenkern (NCK). Fig. 19, on the other hand, has two such, but unequal, systems, so has fig. 17. In this latter, one system is stuck on to the nuclear wall, while a third system of four or five vesicles is present near the Golgi remnant. Fig. 22 is the stage where some of the vacuoles are attached to the post-nuclear body. Stages later than this are found without these vacuoles on the post-nuclear body, indicating that this system is probably got rid of along the tail during the subsequent stages, for amongst the bundles of ripe sperms the vacuoles are seen scattered about as red vesicles (fig. 23).

The number of these vacuoles constituting the system varies not only in different spermatids of the same animal, but also in spermatids from different individuals; for in some cases the number may be quite large at a certain stage of metamorphosis, whereas in a cell at that very stage from a different individual the number may fall down as low as five or six. Attention is here drawn to the fact that a spermatid does not contain more than four Golgi bodies, and the spermatocyte more than eight. Thus the number of the vacuoles does not necessarily correspond to the number of the Golgi bodies.

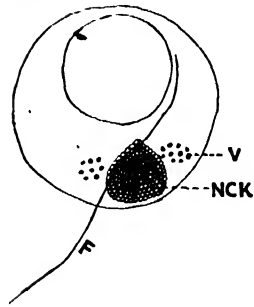
Here I should like to point out that at times large neutral red staining vesicles are also found with other smaller vesicles surrounding them (fig. 24 (a)), and sometimes these latter come in relation with the bigger ones (fig. 24 (b)). Those that come in relation are always much smaller than the others constituting the rest of the system. This arrangement reminds one of the reservoir with its contractile vacuoles found in so many Protozoa; but how far this vacuolar system as found in the germ-cells can be compared with such a system in the Protozoa is doubtful.

Lastly it should be mentioned that in X-rayed specimens the vacuoles did not seem to suffer in any way as long as the cell showed signs of life. All the other cytoplasmic structures, on the other hand, were more or less affected. This again goes to prove, as previously pointed out by Gatenby (1929), that the vacuoles are probably of the nature of metaplastic products, and do not constitute a third category of cytoplasmic inclusion.

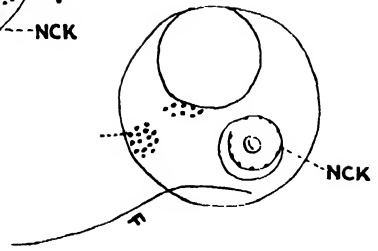
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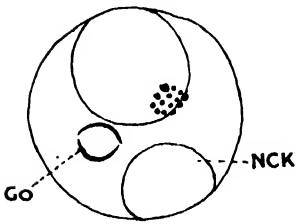
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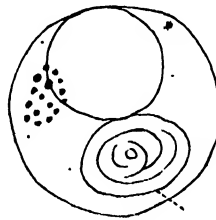
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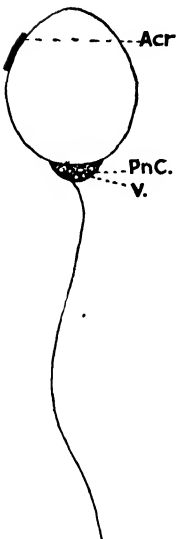
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21.



22.



V.

23.



24B.



24A.

DISCUSSION.

Much that has to be discussed has already been incorporated in the text, but a few facts about the formation of the acrosome remain to be mentioned. Bowen (1924) mentions that the acroblast of *Lepisma* is of a multiple nature, i.e. the individual Golgi bodies retain their separate identity, and that the actual deposition of the acrosome takes place a little at a time as in the case of *Lepidoptera*. My observations not only fail to corroborate this statement, but conclusively show that the process of acroblast formation in *Lepisma* follows more or less the same general principle as the *Hemiptera*, though occasionally a stray Golgi body may be found to behave differently and keep away from the proper acroblast.

SUMMARY.

1. The spermatogenesis of *Lepisma* is not of an atypical kind, for the process is similar to that of *Pygæra* and *Cicindela*.

2. The acrosome is not centrosomic in origin, as stated by Charlton—what he calls an acrosome really being the acrosome plus the centrosome.

3. The acrosome of Bowen in *Lepisma* is the post-nuclear body which is probably present in all animal spermatogenesis.

4. While speaking of the acrosome and its function, Bowen (1924) says that “the case of *Lepisma* appears to be a complete *reductio ad absurdum* of the ‘cutting tool theory.’” Though this “cutting tool theory” is not without its defects, the position of the acrosome in *Lepisma* is apical, as in all other flagellate sperms, so that the evidence provided by this insect does not militate against the “cutting tool theory,” as supposed by Bowen.

5. The centrosome is placed immediately behind the acrosome in a metamorphosing spermatid. It becomes distinctly visible while the differentiation of the acrosome is going on at the apex of the elongated nucleus.

6. The vacuolar system consists of small vesicles aggregated together, as in the germ-cells of *Abraxas*, *Cavia*, *Saccocirrus* and *Macrothylacia*. They are usually separate from the Golgi bodies, though often one or two Golgi rodlets may lie close to them. The presence of two systems of vacuoles is also not uncommon. During the deposition of the acrosome the system seems to behave in two different ways—either it keeps close to the acroblast or it gets stuck on to the wall of the nucleus.

7. The number of vacuoles has no relation to the number of the Golgi bodies. The number varies in cells of the same stage taken from different individuals.

8. The vacuoles are thrown down along the tail.

9. X-radiation seems to have no effect on the vacuolar system, while all other cytoplasmic structures are more or less affected, thus showing that the vacuoles are probably of the nature of metaplastic products.

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DESCRIPTION OF PLATES.

PLATE I.—Spermatogenesis of *Lepisma*. Figs 1-8.

PLATES II. and III.—Spermatogenesis.—*Lepisma* intra-vitam staining with neutral red. The vacuolar system is shown red. Figs. 9-24.

LETTERING.

Acr.	= Acrosome.	Mt.	= Mitochondria.
F.	= Filament.	C.	= Centrosome.
PnC.	= Post-nuclear body.	V.	= Vacuolar system.
Acr.Bl.	= Acroblast.	G.R.	= Golgi remnant.
Go.	= Golgi body.	NCK.	= Nebenkern.
		Ves.	= Mitochondrial vesicle.

II.—THE DEMONSTRATION OF BACTERIAL FLAGELLA.

By JAMES CRAIGIE, M.B., Ch.B.

From the Department of Bacteriology, University of St. Andrews,
University College, Dundee.

(Read December 19, 1928.)

ONE PLATE.

I.—GENERAL DESCRIPTION.

THE staining of bacterial flagella has always been regarded as the most difficult and uncertain of bacteriological staining methods. Here, of course, the term "staining" connotes the selective production of a precipitate of metal or dye on the structures which we wish to demonstrate. The writer had found it necessary to have available a method of demonstrating flagella which should be easy to carry out, constant and uniform in its results, and free from the background of precipitate which is so apt to mar otherwise satisfactory preparations. Existing methods were investigated, but none yielded the desired results, and finally the methods to be described here were elaborated from the basis of Zettnow's original procedure.

But before proceeding to a detailed description of these, it is instructive to examine the points wherein the usual methods are apt to fail. These concern fixation of the flagella, removal of electrolyte from the preparation, adjustment of a suitable mordant, and also, where metallic precipitation is used as the final step, the avoidance of background due to over-precipitation.

Heat is the usual fixative of the bacteriologist. He allows his preparation to dry, subjects it to the requisite degree of heat, and then applies his stains. With flagellar preparations the same procedure is followed, only some mordants act as fixatives and thus replace heat. But the moment that we allow an unfixed suspension of flagellate bacteria to dry, more or less extensive damage is done to the flagella. They are apt to become detached during drying, and, unless one has been fortunate enough to secure drying under optimum conditions, further damage is done to them, so that only a proportion of the original flagella are possible of demonstration. Obviously, the flagella should be fixed before any further steps are taken. For this purpose the writer employs a 1 p.c. to 2 p.c. solution of formalin (40 p.c. formaldehyde). This is not only a most satisfactory fixative, but it also appears to enhance subsequent staining.

The attachment of the fixed suspension to the glass slide is secured by heating the preparation to about 90° C. after it has dried thoroughly. At this stage the preparation will contain a certain amount of soluble salts which it is well to remove. This is simply accomplished by washing with distilled water.

The next step, mordanting, is one where failure is very apt to occur. The principal constituent of most mordants used in this connection is tannic acid. Not only do samples of tannic acid vary greatly in their mordanting power, but even mordant made on different occasions from the same batch of constituents may vary. A modification of Zettnow's mordant, which is easily standardised and is more active than the original, is described below. This mordant is clear at the temperature at which it is applied, but it develops an opacity on cooling. Its mordanting power is related to its capacity for becoming opaque and forming a precipitate. Standardisation is attained by the addition of hydrochloric acid so that the mordant shows a given opacity at a definite temperature.

After the preparations have been mordanted, the flagella may be demonstrated in various ways :—

1. By means of a dark-ground condenser they may be examined without the necessity of further treatment (fig. 1).

2. By the application of routine bacteriological reagents. A stain follows the brief application of Gram's iodine. By this method the flagella are delicately but not intensely stained, if examined in the ordinary way, but are very prominent structures if viewed by dark-ground (fig. 2). Its simplicity makes it useful for class work and for temporary preparations.

3. By a variety of procedures having a basis in Zettnow's silvering method. These may be made to yield either—(a) Monochrome preparations or (b) differential staining where this is called for. Silver is first deposited on the mordanted preparation from a silver sulphate-ethylamine solution. But the disadvantage of Zettnow's original method is that the preparations, if moderately stained, fade rapidly under the action of immersion oil or ordinary mountants. On the other hand, if the preparations are stained very heavily to counteract this tendency, the chances of a disfiguring precipitate are great, and the flagella are rendered unnaturally thick.

The silvered preparations may be made permanent if the silver be replaced by gold or uranium. This is done by immersing the slide in a very dilute solution of the appropriate chloride. This substitution has the additional advantage that it tends to bleach any background or precipitate, and demonstrates the flagella at their true delicacy of structure. Under the action of gold chloride the silvered preparations undergo further differentiation. After a slight general bleaching, intensification of the flagella sets in accompanied by progressive bleaching of the bacterial bodies and also of any background or precipitate. Finally only the flagella may be visible, but the bodies may be counterstained by any simple stain.

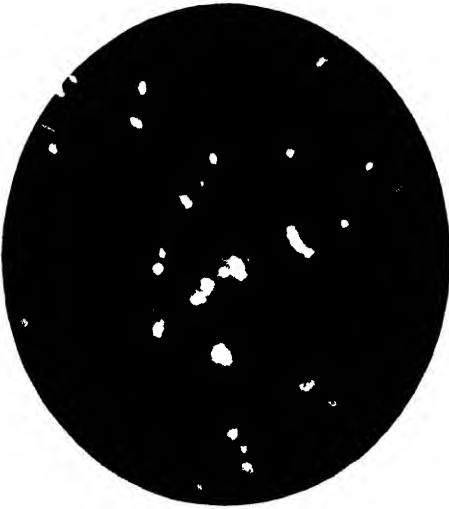


FIG. 1.



FIG. 2.



FIG. 3.



FIG. 4.

If desired, the gold or uranium preparations may be intensified by an ammoniacal solution of pyrogallie acid or hydroxy-naphthionic acid.

Where marked colour differentiation is required, the silver, gold, or uranium preparations, preferably intensified, are subjected to the action of methyl violet (1 p.c. solution). By this means uranium preparations show dark violet bacilli and green-stained flagella.

Of the above methods the writer's preferences are the simple mordant for dark-ground examination, the simple gold for general and photographic purposes, and the uranium-methyl violet for special examinations requiring marked colour differentiation.

II. DETAILED ACCOUNT OF METHODS.

Grease.—Grease must be scrupulously avoided. It combines avidly with the mordant, thus ruining preparations by the formation of precipitates.

Preparation of Slides.—These should be of hard glass. They are stored in a mixture of strong sulphuric acid and potassium bi-chromate. When required, they are washed under the tap, dried with a grease-free cloth, roasted in a Bunsen flame, and allowed to cool.

Preparations of Suspensions.—This varies in detail according to circumstances. Essentially, the suspension, dense if possible, is brought into contact with 1 to 2 p.c. formalin, and allowed to remain thus for at least 15 minutes. The condensation-water growth from a moist agar slope is satisfactory. This is pipeted off and mixed with an equal volume of 4 p.c. formalin in distilled water. Such a formalised suspension keeps for many months.

Preparation of Films.—The stock formalised suspension is diluted with distilled water to a faint opacity. A small drop is placed on a prepared slide and allowed to dry, in an incubator if possible. If this is not available, the drying preparations should be protected from dust. When dry, the preparations are heated to about 90° C. This is conveniently done by placing them on a metal lid which covers a boiling water-bath.

Removal of Electrolyte.—Immerse slide in distilled water for a few minutes, rinse in distilled water and replace over the boiling water-bath until the mordant is ready. (Where much electrolyte is unavoidable a simple phosphate buffer of approximately pH 7 is preferable to ordinary physiological saline.)

Mordanting.—(a) *Preparation of Mordant.*

1. *Zettnow's Mordant.*—Dissolve 10 gm. of tannic acid (pure and light, not commercial variety) in 200 c.c. of distilled water. Heat solution to 60° C. and add slowly with frequent agitation 80 c.c. of a 5 p.c. aqueous solution of tartar emetic.

2. *Adjustment of Mordant*.—Bring the mordant to 75° C. It should become entirely clear. Add hydrochloric acid drop by drop, agitating the flask vigorously, until a faint opacity persists. Allow to cool and add a crystal of thymol as preservative.

On cooling, this mordant becomes very opaque and must be heated to nearly 100° C. before clearing occurs. But when clear, considerable cooling can take place before opacity reappears. If this mordant fails to "bite" satisfactorily, cautiously add more hydrochloric acid to it.

(b) *Application of Mordant*.—Place a sufficient quantity of the mordant in a boiling tube and bring to boiling point. If the mordant does not clear immediately, wait for a few moments and then apply further heat.

The slides, which have been heating over the boiling water-bath, are removed to a staining rack and, without delay, are evenly flooded with the hot mordant. Leave for five minutes or so, when the mordant will be showing a slight opacity and a surface film. Flood off the mordant under the tap, keeping the slide in a horizontal position so that no film may settle on the preparation. Remove dried mordant from the edges of the slide by wiping with a cloth. Rinse again.

One has now a choice of methods :

- (1) Dark-ground examination. The slide is now dried and examined by means of a paraboloid condenser.
- (2) Simple staining. Apply Gram's iodine solution for thirty seconds. Rinse. Stain with 1 p.c. methyl violet or slightly diluted carbol fuchsin for five minutes or more.
- (3) Silvering and replacement of silver by another metal.

Silvering.—To a 0.4 p.c. solution of silver sulphate add a 33 p.c. monoethylamine solution drop by drop until the resulting precipitate just clears up. Flood the mordanted slides with this mixture and warm their under-surface with the tip of a luminous Bunsen flame until they just begin to steam. The preparation will turn a brown colour and, if left, finally become black. It is to be emphasised that the preparations must not be allowed to become too dark in colour. A black preparation is not only coarse and unnatural on account of excessive precipitation, but usually has also a background of metallic precipitate.

If a black cloud appears in the solution in the slide before the process is complete, wash off the solution and replace by fresh. When sufficient reduction has taken place, flood off the silver solution under the tap, taking care to keep the slide horizontal so that no metallic film settles on its surface.

(Such preparations may be stained further by the application of a 1 p.c. watery solution of methyl violet.)

Replacement of Silver.

(a) *Gold Method*.—To 50 c.c. of distilled water add 10 to 30 drops of a 1 p.c. solution of photographic gold chloride. Place the silvered slide in this and leave for 30 minutes to 15 hours. Long exposure leads to almost complete bleaching of the bacterial bodies. These may then be stained with any desired simple stain.

(b) *Uranium Method*.—Immerse silvered slide in a weak solution of uranium chloride—0.1 p.c. or weaker. When change in colour is complete (15 minutes is sufficient), remove, wash, and intensify with

Pyrogallie acid or hydroxy-naphthionic acid	0.05 to 0.1 gm. approx.
Water	10 cc.
Liq. ammoniæ fort.	5 drops

for two to five minutes. Rinse slide and stain with methyl violet for five minutes.

DESCRIPTION OF PLATE.

Photographs taken with Leitz "Makam" micro camera attachment. Magnification $\times 800$.

Fig. 1.—*B. typhosus*. Mordant only. Spencer dark-field illuminator, Type B.

Fig. 2.—Flagellar suspension; *B. typhosus*. Mordant, followed by Gram's iodine and methyl violet. Spencer dark-field illuminator, Type B. There is some fragmentation of the flagella due to method of detachment. Note apparent difference in thickness to those shown in Fig. 1.

Fig. 3.—*B. typhosus*. Gold method.

Fig. 4.—*B. proteus*. Gold method. Note granular appearance and partial decolorisation of bacilli, particularly of large bacillus.

III.—A NEW SPECIES OF BALANTIDIUM FROM THE INTESTINE OF THE BENGAL MONKEY (*MACACUS RHESUS*).

By EKENDRANATH GHOSH, M.Sc., M.D., F.Z.S.,
Professor of Biology, Medical College, Calcutta.

THE body is elongately ovate, nearly or less than twice as long as broad. The body is oval in transverse section. The anterior end is tapering and blunt. The posterior end is blunt.

The peristome is triangular and is placed in front and at the side ; it is one-fourth the body in length.



× 460.

The macronucleus is circular and disc-like with convex sides ; there is a chromatin mass in the centre ; it is placed just in front of the middle of the body towards one side.

The single spherical contractile vacuole is posterior and terminal.

Measurements : length 0·01–0·0117 mm. ; breadth 0·0054–0·00525 mm.

Numerous specimens of this species were found in the intestine of the common Bengal monkey.

Taking the above characters together, the animals represent a new species. It may be named *Balantidium rhesum*.

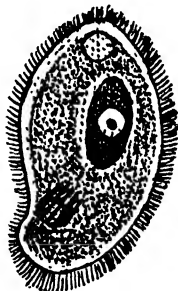
IV.—A NEW CILIATE FROM THE INTESTINE OF THE COMMON BENGAL MONKEY (*MACACUS RHESUS*).

By EKENDRANATH GHOSH, M.Sc., M.D., F.Z.S.,
Professor of Biology, Medical College, Calcutta.

(Read December 19, 1928.)

THE body is flattened and elongately ovate, being less than twice as long as wide; the widest portion lies behind the middle. The anterior end is somewhat tapering, rounded, and is slightly bent to the left side. The posterior end is tapering to a rounded or bluntly pointed end. The dorsal surface is convex. The ventral surface is flattened. The ventral surface and its margin are ciliated; the cilia are longest in the anterior portion of the body. There is no dorsal row of cilia.

The cytostome is circular and is placed at about the junction of the anterior one-fourth or one-fifth with the posterior three-fourths or four-



× 675.

fifths of the body length towards the left side. The cytopharynx is short, truncately conical, and is directed, from above, downwards, forwards and to the left. There is a rod apparatus.

The ectoplasm is thick. The endoplasm is coarsely granular. The macronucleus is oval and is placed in the middle or slightly towards the posterior region of the body; it is surrounded by a clear space of endoplasm which varies in extent in different individuals. In stained specimens the macronucleus consists of a large clear oval area, with a small mass of chromatin in the centre. The clear area is surrounded by dense chromatin granules which fill up the rest of the macronucleus. The micronucleus could not be detected.

The contractile vacuole is spherical and postero-terminal.

Measurements: length 0·05–0·065 mm.; breadth 0·0263–0·042 mm.

There were numerous specimens in the intestine of the common Bengal monkey.

The animalcules belong to the genus *Chilodon* Ehr.

The present species differs from *C. cucullulus* (Mull. sp.), *C. steini* Blockmann, *C. propellus* Engelm., *C. schewiakoffi* Schout., *C. piscatoris* Blockmann, *C. candatus* Stokes, *C. labiatus* Stokes, and *C. notamoibos* Maginsky, in the absence of an adoral row of cilia, and from the first five species in its short cytopharynx. It further differs from *C. dubius* Maup., *C. dentatus* (From.), *C. uncinatus* Blockmann, in having a very short straight rod apparatus. It agrees with *C. propellus*, *C. schewiakoffi*, *C. dubius* and *C. dentatus* in having a single contractile vacuole, but differs from them in many respects.

The species of *Chilodon* are interesting from their infesting the vertebrate animals. *C. cyprini* is known to infest the skin of fish. *C. dentatus* has been found in the dysenteric stool. *C. uncinatus* has also been found in the stool of a man suffering from schistosomiasis. The present species has been found in the intestine of the common Bengal monkey.

The present species may be named *Chilodon rhesus*.

I acknowledge my gratefulness to Assistant Surgeon Biraj Mohan Das Gupta, Assistant Professor of Protozoology, Calcutta School of Tropical Medicine, for having brought the specimens to me.

ABSTRACTS AND REVIEWS.

ZOOLOGY.

(Under the direction of G. M. FINDLAY, M.D.)

STAINING AND IMPREGNATION METHODS.

The History of Staining—Cochineal Dyes.—H. J. CONN and S. I. KORNHAUSER (*Stain Technol.*, 1928, 3, 110–21). Carmine is derived from the female of the cochineal insect, *Coccus cacti*, a native of Mexico. There is considerable difference in the quality of the cochineal obtained from different sources, the product from wild insects not proving as good as that obtained from the cultivated forms. The dye in carmine is carminic acid, a compound the composition of which is unknown. Carmine itself is not soluble in water, the two compounds commonly used being ammoniacal and aceto-carmine. The work of Gerlach (1858), who showed the first practical methods of employing the dye, and of his followers, is discussed at length. A full bibliography is appended. G. M. F.

Types of Safranin and Their Use.—R. HAYNES (*Stain Technol.*, 1928, 3, 143–4). There is considerable variation in the staining properties of various samples of safranin. This cannot be explained by dye content or by the nature of the dye itself, but is probably connected with the salt content. G. M. F.

Reactions of Basic Dyes with Cyclic Derivatives of an Acid Character.—W. C. HOLMES and R. M. HANN (*Stain Technol.*, 1928, 3, 122–30). The recent discovery that the actual staining agent in the Ziehl-Neelson technique is an addition product of the phenol and the dye led to an investigation of the products of various basic dyes with a considerable variety of cyclic derivatives of a phenolic or acid character. Basic dyes form, in general, addition products with typical phenols. With more definitely acid cyclic derivatives the reaction is primarily metathetical, resulting in the formation of organic salts of the dyes. In some instances both metathesis and addition result. Aqueous solutions of fuchsin hydroquinone and resorcinolate and phenolate compounds stain the tubercle bacillus or spirochaetes intensely, but are difficult to differentiate. G. M. F.

Wright's as a Differential Spore Stain.—L. O. DUTTON (*Stain Technol.*, 1928, 3, 140–2.) A method of differential spore staining using Wright's solution is described. A heavy suspension of the organism to be stained is made in 0.4 c.c. of a phosphate buffer solution of pH 7.6 in a fairly large test tube. To this suspension 0.1 c.c. of Wright's staining solution (50–100 m.g. to 60 c.c. of methyl alcohol) is added. The tube is then tightly stoppered, to prevent evaporation of the alcohol, and immersed in boiling water for ten minutes. On removal it is

cooled for half a minute to prevent the contents from bubbling out when it is opened. Loopfuls of the stained organism are then spread on slides and dried. The spores stain blue, the rest of the cytoplasm reddish brown. G. M. F.

Investigation of Thiazin Dyes as Biological Stains.—R. HAYNES (*Stain Technol.*, 1928, 3, 131-9). The effect of buffer solutions of varying reaction on staining fixed sections with thionin, azures A, B and C and methylene blue, has been studied. The buffer solutions were employed in one of three different ways: for pre-treatment of the sections, for post-treatment, or as solvents for the dyes. Regardless of the method of employment, it was found that the intensity of staining increased with increasing pH values (a fact which is generally known to be true in the case of basic dyes). Whether this effect is due to varying the H-ion concentration, or to altering the salt content of the solution, or to both, is unknown. There was one point, either between pH 5 and pH 6 or between pH 6 and pH 7, its position varying with the method of fixation and of applying the buffer solution, where the staining intensity increased most rapidly. It was further observed that between pH 5 and pH 7 there were always more pronounced metachromatic effects than with either more acid or more alkaline buffer solutions. G. M. F.

GENERAL CYTOLOGY.

Tissue Culture from the Standpoint of General Physiology.—E. N. WILLMER (*Biol. Rev.*, 1928, 3, 271-302). A review of the present knowledge of tissue culture from a physiological point of view. An extensive bibliography is appended. G. M. F.

Thyroxin as a Depressant of Cell Division.—H. B. TORREY ("Thyroxin as a Depressant of Cell Division: its Effect on the Cleavage and Early Development of Sea-Urchin and Ascidian," *Endocrinol.*, 1928, 12, 65-80). Thyroxin does not accelerate the cleavage rate or differentiation processes in the eggs of *Echinometra* or *Phallusia*, but retards them, the effect varying in degree with the concentration of thyroxin. The effect is not primarily due to the iodine in the thyroxin. G. M. F.

The Golgi Apparatus as an Artefact.—C. E. WALKER ("Artefacts as a Guide to the Chemistry of the Cell," *Proc. Roy. Soc. B.*, 1928, 103, 397-403, 2 pls.). When a cell is fixed, the position and arrangement of the lipins in relation to the nucleus are probably due to or are influenced by some chemical change in the nucleus. When methyl myristate or methyl laurate in which yellow phosphorus is dissolved are added in the form of an emulsion to certain colloidal mixtures and kept at a temperature of 30° C., the microscopic appearances presented on fixation and treatment with osmic acid show that in about two hours a large proportion of the lipins are distributed over the globules, while after twenty-four hours most of the fatty acids of the lipins have become saturated or oxidised. G. M. F.

Secretion in the Thyroid Gland.—R. J. LUDFORD and W. CRAMER ("The Mechanism of Secretion in the Thyroid Gland," *Proc. Roy. Soc. B.*, 1928, 104, 28-38, 1 pl., 22 text-figs.). From a cytological study of the thyroid gland in exophthalmic goitre in the mouse and man it is found that there is considerable enlargement of the mitochondria and Golgi apparatus. The polarity of the Golgi apparatus is frequently reversed. The secretion droplets formed in association with the reversed apparatus, in the case of the mouse, are discharged directly into the blood capillaries, while in the normal gland the secretion is discharged first into the lumen of the vesicle. G. M. F.

Nuclear Alterations in the Liver in Experimental Yellow Fever.—C. MAGARINOS TORRES ("Alterações nucleares das células do fígado nas infecções de *Macacus rhesus* et *M. cynomolgus* pelo vírus da febre amarela," *Suplemento das Mem. do Instit. Oswaldo Cruz.*, 1928, 2, 55–61, 1 pl., 2 figs.). In the nuclei of the liver cells of monkeys infected with the virus of yellow fever there occur in varying numbers oxyphilic bodies similar to those found in herpes, varicella, and some other virus diseases. G. M. F.

Observations on Spermatogenesis in *Drosophila*.—C. W. METZ (*Ztschr. f. Zellforsch. u. Mikrosk. Anat.*, 1926, 4, 1–28, 5 pls., 7 text-figs.). *D. virilis*, *melanogaster*, *willistoni*, *funnebris*, and *obscura* were studied. The most favourable form is *funnebris*, but other species are used in the main account because of their known genetic behaviour. Homologous chromosomes undergo synapsis in the telophase of the last spermatogonial division and remain in intimate association during the growth stages. The sex chromosomes remain rather condensed and attached to, or a part of, the nucleolus, while the autosomes become diffuse in the early growth stages and are so indistinct they cannot be followed. No indication of threads, as found in leptotene and diplotene stages of many animals, are observed in *Drosophila*. The nuclear wall remains intact in both maturation divisions, and permits a distinction to be made between cytoplasmic and nuclear materials. Both divisions are normal and the first is reductional. The Y chromosome remains dense, while the X chromosome behaves like an autosome. "It is difficult to attach any positive significance to the chromosome behaviour so far as the question of genetic crossing over is concerned." *Biological Abstracts.*

The Golgi Apparatus in Glandular Cells of the Prostate.—J. M. O. PICON ("Sobre el aparato reticular de Golgi en las células glandulares de la próstata," *Rev. españ. Ciruj. y Urol.*, 1926, 8, 1–11, 3 text-figs.). The author studied three fresh hypertrophic human prostates, employing the uranium-formol reduced Ag method of Ramón y Cajal. He found that in the glandular cells the apparatus is large, lies between the nucleus and the free border of the cell, and is of different forms. The broader plane of the reticulum is perpendicular to the longitudinal axis of the cell. No morphologic changes related to secretory phenomena were observed. Between the stroma and the glandular epithelium are endotheliiform cells, each with a small Golgi apparatus formed by several spherulæ. *Biological Abstracts.*

The Chromosomes of Rats.—G. PINCUS ("A Comparative Study of the Chromosomes of the Norway Rat (*Rattus norvegicus* Erxl.) and the Black Rat (*Rattus rattus* L.)," *J. Morph. & Physiol.*, 1927, 44, 515–38, 66 text-figs.). Excellently preserved tissue was had for both *R. rattus* and *R. norvegicus*. Examination of 12 spermatogonial cells in the former and of 20 in the latter species showed that *R. rattus* has 40 diploid chromosomes and *R. norvegicus* 42. Examination of first and second spermatocytes confirmed the diploid determinations. That both species have an unequal pair in the spermatogonia, and a similar unequal pair in the first spermatocytes is the evidence for an X–Y mechanism in each. A large K-shaped chromosome was found in *R. norvegicus* tetrads, but not in *R. rattus*. The X–Y complex is in both the spermatogonial and first spermatocyte divisions morphologically different in the two species, the Y's in particular being markedly dissimilar in size. A short discussion as to the bearing of these findings on the origins of the two species and their known intersterility is presented. Marked similarity is noted between the tetrads of the black rat and those described for the mouse. *Biological Abstracts.*

Rôle of Atypic Sperm in Formation of Nutritive Eggs.—A. PORTMANN ("Le rôle du spermatozoïde atypique dans la formation des œufs nourriciers de *Buccinum undatum* L.," *Arch. Zool. exp. et gen.*, 1926, **65**, 103–24, 18 text-figs.). In a mass of 100 eggs of *B. undatum*, form embryos only 3–5 (rarely 20). The non-viable eggs break up into simple vitelline spherules which nourish the growing embryos. The disintegration of the nutrient eggs is attributed to their having been fertilised by atypic sperms. In viable eggs fertilisation presumably occurs in the oviduct, and the eggs are laid during the first maturation division. Maturation has not been observed in nutrient eggs. However, the spindle of the first maturation is formed, but takes the position of the cleavage spindle in normal eggs, has indistinct asters, and in metaphase may be bent strongly to meet the sperm pronucleus, which usually has three asters. In the nutrient eggs of *Murex trunculus* L. both polar bodies are extruded, the first normally dividing. Several abnormal cleavages divide the animal pole into a number of globules. In the nutrient eggs of *Purpura lapillus* L. there are no maturation divisions, and cleavage, though irregular, is more nearly equal than in *M. trunculus*.

Biological Abstracts.

The Spermatogenesis of the Pribilof Fur Seal (*Callorhinus alascanus* Jordan and Clark).—D. J. STARKS (*Am. J. Anat.*, 1928, **40**, 471–99, 3 pls.) Two generations of spermatogonia are recognised, the large, or primary, and the smaller, or secondary, ones, readily distinguishable from each other and from the Sertoli cells. The nuclear transformations are described in detail up to the beginning of spermatid differentiation in spermiogenesis. The diploid number of chromosomes seems to be $28 + X-Y$, the latter being indicated in both generations of spermatogonia as well as in the spermatocytes. The haploid number is $14 + X$ or Y . Parasynapsis takes place; reduction occurs in the first spermatocyte division, the second being equational. Division of the primary spermatocytes is followed by a brief interkinetic resting stage.

Biological Abstracts.

Chondrioma and Golgi Apparatus in the Lutein Cells of the Dog.—N. GOORMAGHTIGH ("Le chondriome et l'appareil de Golgi dans la cellule lutéinique de la chienne," *Bull. Hist. appl. Physiol. et Path.*, 1926, **3**, 271–82, 11 text-figs.). The fat granules of corpus luteum represent material brought by the blood stream and assimilated by the cell. They undergo chemical changes leading to the formation of the hormone that is poured out in the lymph vessels. This is shown by the fact that each cell has a vascular pole and a lymph pole. The chondrioma is always oriented towards the blood-vessel and situated between arterial pole and nucleus. The differentiation of the mitochondria depends on their position in the cell. They possess the facultative property of supporting lecithin liposteric droplets. Their number and morphology vary according to the fat-granule content of the cell. Hence it is suggested that the chondrioma plays a part in the assimilation process of fat and lipid material brought by the blood. The Golgi apparatus is closely connected with the chemical changes of the fat droplets. When the cell is filled with fat granules, the Golgi apparatus appears as a system of osmiophile spheres fitted on the droplets. When the latter fade away, a colourless fluid oozes between them and the osmiophile sphere. This leads to a very irregular outline of osmiophile Golgi apparatus. The Golgi apparatus represents zones of the cell where the reaction of the protoplasm on the assimilated and temporarily stored material is at work. It indicates preparatory changes to excretion under control of the nucleus.

Biological Abstracts.

Observations on the Kurloff Bodies.—P. LAMBIN and G. PIERAERTS ("Quelques observations sur les corps de Kurloff," *Compt. rend. Soc. de biol.*, 1927, 96, 145-7). From study of nuclear structures the authors maintain that these bodies occur only in lymphocytes, never in monocytes, and reject the commonly accepted opinion that these bodies have a homogeneous structure, and that morphologic variations in this respect are due to artefacts. Studied in May-Giemsa preparations, the variations are such as to warrant the contention that lymphocytes with Kurloff bodies have a secretory cycle. The initial process is represented in lymphocytes having one or several azurophilic granules larger than the rest. That these by hypertrophy and fusion differentiate into mature, uniformly azurophilic, large Kurloff bodies is considered evident from the many intergrade granules met with, and from the fact that lymphocytes were found having two to three azur granules in the transformation stage; but seldom were lymphocytes having two Kurloff bodies observed. In types having only a few azure granules an oxyphilic substratum was noted. From this it is concluded that the azurophilic Kurloff body transforms into an oxyphilic one. Developmentally, the bodies consist of azurophilic and oxyphilic substances mixed in a homogeneous mass, the latter increasing with the diminution of the former. Since the fully oxyphilic stage is very rarely met with and is of short duration, the authors conclude that at this point the substance of the Kurloff bodies is excreted from the cell *in toto*.
Biological Abstracts.

Normal and Polyploid Chromosomes Complexes* in Species of *Drosophila*.—S. FROLOWA ("Normale und polyploide Chromosomen garnituren bei einigen *Drosophila*-Arten," *Ztschr. f. Zellforsch. u. Mikrosk. Anat.*, 1926, 3, 682-94, 14 text-figs.). The chromosomes of eight Russian species of *Drosophilidae* are described from oogonia and spermatogonia, and the attempt is made to classify them on the basis of types A, F, C, I, etc., of Metz's previous descriptions. The chromosomes of *D. ampelophila* from Krim cannot be distinguished from the American races. *D. vibrissima* is similar to *ampelophila* except that pairs 2 and 3 differ more sharply in length. *D. funebris* and *D. hystrio* have 6 chromosome pairs—4 short rod-shaped, 1 large rod-shaped, and 1 small m pair corresponding to type G. The size of m is the chief distinguishing feature between the two, being very tiny in the former species. *D. transversa* and *D. phalerata* are indistinguishable and belong to type F. They have 5 chromosome pairs, including m. *D. obscura* has 5 pairs—4 V-shaped and 1 m pair. The Y is a short rod half the length of the X. This does not agree with the American *D. obscura* Fall. Doubtless two species are involved, one of which is incorrectly determined. *D. trivittata* is described from two figures of oogonia as having 2 pairs of short rods, 1 pair very large V-shaped, and an m pair. The figures also show another pair of short rods not described. Polyploidy is described in the somatic cells of the various species. In the tracheal cells of the pupae tetraploidy is uniformly found, and in the rectal gland cells octoploidy is the rule. These conditions are not accidental, for in the organs mentioned cells with diploid complexes have never been found.
Biological Abstracts.

Oogenesis in *Limulus polyphemus*, with Especial Reference to the Behavior of the Nucleolus.—M. S. GARDINER (*J. Morph. & Physiol.*, 1927, 44, 217-58, 2 pls.). Cytoplasmic alterations in the ovarian egg leading to formation of yolk are described. The nucleolus arises by the confluence of substance which passes from the cytosome into the nucleus, and it is suggested that the chondriosomes, and possibly the dictyosomes, are derived from an excess of this substance

which accumulates in the cytosome. Chondriosomes and dictyosomes are not present in the oogonia, but appear first in oocytes after the formation of the nucleolus is completed. During oogenesis the nucleolus is very active and the greater part of its substance is passed back to the cytosome. By the method of Bell and Doisy for the determination of phosphate in body fluids, the nucleolus is found to be richer in phosphorus than are the other constituents of the cell. The nucleolar emissions effect the transport of phosphorus from the nucleus to the cytosome, where it is used in the synthesis of yolk. The definitive yolk arises by the interaction of nucleolar emissions, chondriosomes, dictyosomes, and ground cytoplasm.

Biological Abstracts.

Constrictions in the Chromosomes of *Drosophila melanogaster*.—C. B. BRIDGES (*Biol. Zentralbl.*, 1927, 47, 600-3, 1 text-fig.). Detailed study has shown that these chromosomes are segmented in regular fashion. The X-chromosome has two constrictions. The segment proximal to the point of spindle-fibre attachment is of smaller diameter and often slightly offset at this joining. In late metaphase the distal segment is the first to split. The V-shaped autosomes have two constrictions in each arm, the Y-chromosome but one. Lengths of segments, their constrictions, and relative diameters may assist in interpreting such aberrations as deficiencies, duplications, inversions, translocations, and fragmentations.

Biological Abstracts.

Activation of the Egg.—A. DALCQ (*Rev. Univ. Bruxelles*, 1926, 31, 349 71 and 535-56). Outline of conferences held with students of biology, together with the results of some unpublished research. The protective and adaptive value of the cortex and its reactions are emphasised; the importance of membrane elevation has been greatly exaggerated; the mechanism of monospermy is considered, and Lillie's theory of fertilisation summarised. The mechanism of segmentation is treated in a general way. The initiation of egg metabolism only follows the appearance of a monaster of cyclic evolution. Analysis of experimental parthenogenesis (Loeb) shows that secondary conditions are necessary for the appearance of an amphiaster (consistent with the normal segmentation) in place of a monaster. Analysis of cytological results on fertilised eggs of *Rhabditis* and cross-fertilised eggs of echinoderms and batrachians enables us to conclude that it is the sperm which carries the factors indispensable for bipolarisation of the gel of the aster. The author discredits Boveri's sperm-centrosome theory, both on account of Lillie's experiments on *Nereis* and on account of original observations. In frog's eggs fertilised with trypan-flavin-treated sperm, the sperm is intact even in the metaphase of the first segmentation. The centrosome is apparently a locomotor apparatus (Lillie). Comparisons are made with Fry's observations on the eggs of *Scutella*. Apparently the hyaline nuclear sap plays the important rôle in amphiaster formation, and not the chromosomes (Fry). The author would not neglect the part played by cytoplasmic factors; these are shown to be important by the magnitude of metabolic events, the growth period of the gametes, the necessity of the cortical layer for fertilisation, and the *mise à l'émission* in eggs blocked in the course of maturation (Brachet). The morphologic and physiologic evidence for depolarisation is presented. Solutions of chlorides isotonic with sea water produce a series of cytologic effects—expansion of the aster gel, polycentry, autotomy of the vegetative pole, more or less typical segmentation with progressive extension of the egg's activity which hitherto was localised at the animal pole. The importance of the principal cations in sea water is considered. In *Asterias glacialis* the eggs are activated by merely upsetting the ionic balance.

It is therefore possible to distinguish the factor initiating karyokinesis and that activating the translocation of cytoplasmic substances (cytodinesis). This is essential for an analysis of the initiation of development. The choice lies between the idea of an inhibition of the unfertilised egg through accumulation of waste products and that of an inertia due to the lack of certain elements. It is the latter idea which at present seems to be the best working hypothesis.

Biological Abstracts.

The Neurogenic Theory of Karyokinesis.—M. MÜHLMANN ("Die neurogene Theorie der karyokinese," *Ztschr. f. Zellforsch. u. Mikrosk. Anat.*, 1926, 3, 337–82, 1 text-fig.). After discussing briefly the unsatisfactory nature of other theories, the author advances the idea that the properties of the central nervous system in the cell lie, not in the nucleus, but in the centrosome. As evidences he cites: This body is present from the Protista up; it is a centre for such motile organs as flagella and cilia; its behaviour at the beginning of cell division; its connection with the spindle fibres. The centriole is called the "neuriol," and the chromatic fibres the "neurofibrilles." Experiments by Shubin are cited on the effects of alkali nerve poisons (especially of pilocarpin) on dividing cells in the root tips on the onion (*Allium cepa*), in which a centrosome is not visible. By a $\frac{1}{100}$ solution cell division was greatly increased; 10 tetrads similar to those of the germ cells were formed, while the achromatic spindle was entirely broken down. The author concludes that while these experiments do not prove the neurogenic theory, some advance towards it is made. He analyses cell growth as a series of steps which culminate in a condition that stimulates the neuriol to bring on division, and states that his theory has in it nothing contrary to the electromagnetic and physical-chemical theories, and that it is favoured by Gurwitsch's induction stream theory.

Biological Abstracts.

Endothelial and Wandering Cells.—E. R. CLARK and E. L. CLARK ("On the Failure of Endothelial Cells, even after Desquamation, to be Transformed into Wandering Cells, with Observations on the Nature of Endothelium," *Anat. Rec.*, 1927, 36, 357–82, 6 text-figs.). Numerous observations of living capillaries and wandering cells in the transparent tails of amphibian larvæ, where individual cells with their nuclei were followed for hours and days, have shown no evidence for the formation of wandering cells from the vessel endothelium, either in normal growth or under experimental conditions. From the first invasion of the fin by capillaries the endothelium and wandering cells are specific types with totally different physiological properties. A few instances of the desquamation of endothelial nuclei with their surrounding cytoplasm from the inner wall of lymphatic capillaries were observed in the living. The desquamation occurred as the result either of a weakened condition of the animal or after mechanical injury. The latter was caused by large wandering cells which migrated from the outside tissue into the capillary and dislodged the nuclei with their perinuclear areas from the vessel wall. The endothelial cells which thus became free did not change into wandering cells, but were incapable of independent movement, and showed nuclear and cytoplasmic changes characteristic of dying cells. The observations afford further evidence for the syncytial character of young capillary endothelium, and for the existence of an endoplasm and exoplasm in the endothelial wall.

Biological Abstracts.

Cell Division Physiologically Considered.—A. GURWITSCH ("Das Problem der Zellteilung physiologisch betrachtet," *Monographien aus dem Gesamtgebiet der Physiologie der Pflanzen und der Tiere*, 11, 221, Julius Springer,

Berlin, 1926). In the introduction the author recapitulates the theoretical deductions developed from his earlier publications regarding the influences which cause differentiation in embryogenesis. To explain the relationships between the intracellular mechanism and the whole of a multicellular organism, the author offers the alternatives—(1) the cells influence one another reciprocally; (2) the cells are influenced by factors related in some way to the whole. According to the second alternative, the cells, in the unfolding of their own potentialities, are influenced by the peculiar properties of the field in which they are found. In applying this idea to the problem of cell division the author suggests that cell division depends upon both intra- and extracellular factors. The existence of an external factor he has shown in the onion and in *Helianthus*, in the root tips of which mitoses cease if the base of a rootlet is clamped or subjected to local narcosis. Regarding the mutual influence of nuclei, reference is made to the many instances in both plants and animals of synchronic mitoses in syncytial territories. When the mononuclear territories become separated by the formation of cell membranes, the synchrony no longer holds. The author argues that the cell membrane is not only responsible for delimiting mitoses, but, by assuming the reactive nature of cell division, serves as the stimulus-perceptive organ for the division impulse. The third chapter deals with the realisation-factors (*Verwirklichungsfaktoren*). He discusses at length Haberlandt's wound- or necro-hormone as a division stimulant apparently of a chemical nature. However, experiments on the spread of mitotic activity from wounds in the frog's cornea and the travel of the division stimulus factor in artificially bent rootlets lead the author to believe in the physical nature of what he terms mitogenetic rays. This finds support in his experiments by which he claims to have demonstrated that mitoses can be induced at a distance. He presents figures to show that the mitotic activity in an onion root (induced root) can be stimulated on that side toward which the tip of another onion root (inducing root) is directed from a distance of 2–3 mm. The existence of a localised stimulation is measured by the greater number of observed mitoses on the side of the induced root exposed to the tip of the inducing root over that of the unexposed side. The so-called mitogenetic rays which produce this stimulus are deflected by glass. The difference in their deflection by quartz and by gelatine suggests their being short-wave ultra-violet rays which lie within the limits of 1900–2000 Angstroms. The rays appear to originate at the base of each rootlet, where a peculiar histological arrangement of cellular tissues has been found by Lydia Gurwitsch. Extracts of the tissues of this region have been fractionated into two substances provisionally named "mitotin" and "mitotase." Further sources of mitogenetic rays have been found in seedlings of *Helianthus*, fresh sections through the leptome of potato tubers, and frog tadpoles. All of them stimulate mitoses in the onion rootlet. In the second part of the book the author extends his views of the physical characters of a substance stimulating cell division to explain mitoses in embryonic and developing organs. In the third section the author deals with the polarity of the cell during the resting stage and during mitoses. Chromosomes and their genes are discussed, and emphasis is laid on their specific configuration, mutual arrangement, and orientation to serve as a unified system in heredity.

Biological Abstracts.

Gigantism and Triploidy in the isopod *Trichoniscus provisorius*.—

A. VANDEL ("Gigantisme et triploidie chez l'isopode *Trichoniscus* (*Spiloniscus*) *provisorius* Racovitza," *Compt. rend. Soc. de biol.*, 1927, **97**, 106–8, 1 text-fig.). The parthenogenetic triploid race of *T. provisorius* constitutes another example (cf. *Artemia salina*) of the interdependence of polyploidy and gigantism in animals.

The violaceous parthenogenetic ♀ with 24 chromosomes have a mean length of 4.5 mm. as opposed to the 3.3 mm. and 3.17 mm. respectively of the brown to orange sexual ♂ and ♀ having the diploid number. The nuclei of the parthenogenetic race being larger and heavier than those of the sexual race, this may be considered as a case of hypertrophy. *Biological Abstracts.*

Conjugation in the Ciliated Protozoon, *Dileptus gigas*, with Special Reference to the Nuclear Phenomena.—J. P. VISSCHER (*J. Morph. & Physiol.*, 1927, 44, 383–415, 26 text-figs.). In conjugation, fusion occurs along the entire oral surfaces of the proboscides. Two size-reducing divisions occur in rapid succession immediately preceding conjugation. Only one of the many micronuclei takes part in the process of nuclear reorganisation. All other chromatic material is massed at this time in the posterior portions of the conjugants. The pronuclei are derived from the single active micronucleus, and interchange occurs immediately preceding the separation of the mating individuals. The fertilisation nucleus divides to form two nuclei of diverse size. The smaller produces 32 or 64 micronuclei, which the larger divides to produce a like number of macronuclei, each of which finally breaks up into many chromatic granules which form the numerous densely staining nuclear derivatives characteristic of the vegetative stage of *D. gigas*. In the early stages specimens are frequently found with two to eight distinct nuclei often arranged in a series as in a beaded nucleus. This condition probably explains the frequent references in literature regarding such a nuclear condition in *Dileptus*. *D. gigas* has accordingly, in the vegetative stage, a multinucleate condition with reference to the micronucleus and a fragmented or distributed condition with reference to the macronucleus. *Biological Abstracts.*

INVERTEBRATA.

Mollusca.

The Affinities of *Cecilioides* and *Ferussacia*, illustrating Adaptive Evolution.—H. WATSON (Presidential Address, *J. Conchol.*, 1928, 18, 217–43, 2 pls., 11 text-figs.). The shell, colour, head and sense organs, foot and glands, mantle-edge, anal gland, respiratory system, excretory system, digestive system, retractor muscles and genital system of these two forms are minutely described. They possess many features in common, and differ from many other genera with somewhat similar shells in having a well-defined foot-fringe, a large and elaborate anal gland, a sigmurethrous kidney prolonged beside the rectum, and with an anteriorly bifurcated ureter, a bulimuloid jaw combined with a typically stenogyroid radula, and a penis divisible into a slender, thin-walled, anterior portion and a broad, muscular posterior part, with a short lateral appendix or pocket. Clearly the two genera belong to the same family. The differences between the two are adaptations to the underground habitat of *Cecilioides*. *Cochlicopa* and *Azeca* are not closely allied to them. Their relationship with *Zonitidæ* and *Endodontidæ* (Orthourethra) is distant. Their old association with *Achatinidæ* seems to be justified. Their affinities with that family are closer than with the *Oleacinidæ* and *Testacellidæ*. The genital organs of *Cecilioides* may be regarded as a simplified version of those of *Ferussacia*. “When a publisher wishes to produce a pocket edition of a book, he can reduce the size of the print and the thickness of the paper and covers, but he cannot do this indefinitely if the book is to remain legible and serviceable; a time comes when he must also abridge the text, abbreviating or cutting out any appendices or other portions which are not really necessary to the main purpose of the work. Similarly, when

in the course of evolution a snail is to be adapted to burrowing into narrow pockets in the soil, much can be done by merely reducing the size of the various organs and the breadth and thickness of the shell. But this cannot be done indefinitely without impairing the efficiency of some of the vital organs, and a time comes when it is necessary to abbreviate or cut out altogether some of the genital appendices or other structures which are not necessary to the survival of the species." The simplifications in *Ceciloides* are thus secondary. The geographical distribution of these forms is described, and an appeal is made to naturalists to give more consideration to *all* the diagnostic points of anatomy, as well as to the behaviour and environment of the animals.

E. W. B.

Conchometry.—A. E. BOYCOTT (Presidential Address, *Proc. Malac. Soc.*, 1928, 18, 8-31) shows the great interest and value of simple statistical methods in conchology, and, indeed, in many other departments of investigation in which we desire to give a more pointed accuracy to our statements about large collections of things. He observed many years ago that the sizes of snails as given in various text-books were not in accordance with observed facts. It transpired on inquiry that the older naturalists selected the largest specimens obtainable as their type-specimens, and that it was no uncommon thing for dimensions to be copied from one book to another. But careful measurement is in itself an attractive thing; one soon learns that to estimate size by the mere look of a thing is as inaccurate as to adopt the gardener's "eighth of an inch" unit. The statisticians, men of figures, showed how large collections of measurements might be shown to agree with or to depart from a normal curve. Their science, like many others, suffers from a want of lucidity in its technical terms, but the practical application of many of them is shown in this address. It is evident that conchometry is an essential method for the study of variation.

E. W. B.

Notes on Some Japanese Zonitidæ.—H. A. PILSBRY (*Proc. Acad. N.S. Phila.*, 1928, 80, 207-10, 8 text-figs.). *Oxychilus hokkaidensis* n.sp. has much the appearance of the common European *O. alliarius* (Miller), but is smaller and has a larger umbilicus and distinct minute spiral sculpture which is wanting in *O. alliarius*. *Luchuconulus okinawanus* n.sp. resembles *Euconulus*, but has bicuspid lateral (i.e. admedian) teeth. *Discoconulus sinapidium* (Reinhardt) differs from *Euconulus* in the radula "by the regular decrease of the teeth from the outer lateral and the bicuspid outer marginals, whereas in *Euconulus* some of the marginals are longer than the outer laterals, and several of the outer marginals have three or four cusps. These are not important differences, but the shell is rather unlike that of *Euconulus*, so that for the present it seems well to continue the distinction which Reinhardt made."

E. W. B.

Review of Japanese Land Mollusca.—H. A. PILSBRY (*Proc. Acad. N.S. Phila.*, 1927, 79, 13-20, 2 pls., 2 text-figs.). Definition of a new sub-genus, *Karaftohelix*, for the group of *Eulota fiscina* Fulton. In the true *Eulotæ* the mucous glands, however branching, enter the accessory sac by two contiguous ducts, or rarely these unite upon entering the sac. In the present group there are many glands entering by independent ducts inserted in a series across the accessory sac near its summit. These forms are not directly related to any of the Japanese species southward, but are traceable to a separate migration from the mainland (Karafuto is in Saghalien). The genitalia of *E. fiscina* Fulton are described and figured. The shells of three species of this group are figured, and four new sub-species of *Eulota (Euhadra) callizona* are described and very beautifully figured.

E. W. B.

The Structure and Affinities of Humboldtiana and Related Helicid genera of Mexico and Texas.—H. A. PILSBRY (*Proc. Acad. N.S. Phila.*, 1927, 79, 165–92, 4 pls., 15 text-figs.). This is a group of belogonous helices superficially resembling *H. aspersa*. Pilsbry's general key classifies them thus:—1. Four mucous glands concrescent into a ring adnate upon the vagina; their ducts incorporated into the walls of the latter; four dart sacs. Tail not specially modified.—*Humboldtiana*. Mucous glands and ducts lying free when present; tail having serrate keel (2). 2. Foot broad; two dart sacs and three mucous glands.—*Lysince*. Foot long and narrow (3). 3. A dart sac and pair of contiguous mucous glands present; penis provided with a flagellum.—*Leptarionta*. No dart sac or mucous glands; no flagellum.—*Tryonigens*. The last is a new genus, with one species (*Helix remondi*, Tryon 1863). E. W. B.

On Some North American Vaginulidæ.—H. HOFFMANN (*op. cit.*, 209–21, 5 text-figs.). Continuation of the controversy between the author and H. B. Baker, who calls the group Veronicellidæ. E. W. B.

Minute Mexican Land Snails.—H. B. BAKER (*op. cit.*, 223–46, 6 pls.). Anatomical notes on small land snails which have been included in or confused with the genus *Thysanophora*. The drawings and descriptions are of considerable interest; several show species allied to the English *Punctum pygmaeum*. E. W. B.

The Anatomy and Phylogeny of Spondylus.—W. J. DAKIN ("The Anatomy and Phylogeny of Spondylus, with a Particular Reference to the Lamellibranch Nervous System," *Proc. Roy. Soc. B.*, 1928, 103, 337–54, 7 text-figs.). The anatomy of Spondylus supports the view of Jackson (1889) that Spondylus has been evolved from Pecten. The more equivalve species of Pecten, like *P. opercularis*, represent the earlier and more primitive type, and the direction which culminated in Spondylus was that which can be seen in the Pectenidæ, leading from *P. opercularis* through *P. jacobæus* and *P. maximus*. The nervous system was found to be peculiar in that the two pedal ganglia are connected to the visceral ganglia. There are no distinct connectives between the cerebral and pedal ganglia. Spondylus must be regarded as the extreme of an evolutionary line which probably began with the Aviculopectens of palæozoic times. G. M. F.

The Eyes of Lamellibranchs.—W. J. DAKIN ("The Eyes of Pecten, Spondylus, Amussium and Allied Lamellibranchs, with a Short Discussion on their Evolution," *Proc. Roy. Soc. B.*, 1928, 103, 355–64, 1 text-fig.). The Pecten type of eye is remarkably uniform, and is only rivalled in complexity among bivalve molluscs by Cardium, but the efficiency of the eye of Pecten is doubtful. The development in size and complexity of the eye is due to internal factors and not directly to adaptation or utility. G. M. F.

Studies on the Shell Proportions of Some Norwegian Mytilidæ.—T. SOOT-RYEN (*Nyt Mag. Naturvidensk.*, 1927, 65, 321–38). The measurements of two dimensions of the shells are placed as dots in a co-ordinate system. All points are bordered by two straight lines, eventually with the exception of aberrant variates, and a formula for the middle variates is found. Thus the ratio between height and length is $H/L \cdot 100 \text{ p.c.} = (K + (p/L)) \cdot 100 \text{ p.c.}$, where K is a constant and p the factor of correction. This factor p corrigates the ratios for the various lengths. The breadth of variation is $\pm (K_1 \div K + (p_1 \div p/L)) \cdot 100 \text{ p.c.}$ As a picture of the volume the ratio $H + T/L \cdot 100 \text{ p.c.}$ is used. Using this method on

Norwegian Mytilidæ, it is found that $H/L \cdot 100$ p.c. L and $H + T/L \cdot 100$ p.c. diminish, while $T/L \cdot 100$ p.c. generally increases as the lengths increase, and that the smallest species, *Modiolus phaseolinus*, has the relatively greatest thickness and volume. For some samples of the three species *Mytilus edulis*, *Modiolus modiolus* and *M. phaseolinus* the ratios H/L , T/L and $H + T/L \cdot 100$ p.c., the average values, the skewness, the breadth of variation and the variability are calculated for various groups of length. A distinct change in the proportions of *M. edulis* is found with the ripening of the gonads, the shell then growing thicker and more swollen.

Biological Abstracts.

Preliminary Experiments on the Artificial Culture of Oyster Larvæ.

—J. HORI and D. KUSAKABE (*J. Imp. Fish. Inst., Tokyo*, 1926, **22**, 177-88, 1 pl., 1 text-fig.). *Palmellococcus* sp., a unicellular green alga, is used as the food of oyster larvæ. Oyster larvæ raised by artificial fertilisation, and fed with *Palmellococcus* sp., grew until their shells measured $220 \times 240 \mu$ in diameter in a month, and some lived for more than 50 days. The development of the common Japanese oyster resulting from artificial fertilisation was studied throughout the shell-larva stages. These larvæ can endure sudden changes of salinity within certain limits. *Noctiluca* and some Cœlenterates are natural enemies of oyster larvæ.

Biological Abstracts.

Further Observations on the Local Variation of *Clausilia bidentata*.—

A. E. BOYCOTT (*J. Conchol.*, 1927, **18**, 131-5). In 1914 *C. bidentata* was collected from 10 restricted loci at Portmadoc, Carnarvonshire. Measurements of altitude and diameter showed that the shells from each locus differed from those from most of the other loci. The observations were repeated in 1924, and it was found that the shells differed from locus to locus as before, that the characteristic size for each locus was maintained, and that the shells in 1924 were generally narrower than they were in 1914.

Biological Abstracts.

Observations on *Margaritana margaritifera*.—K. ALTNÖDER ("Beobachtungen über die Biologie von *Margaritana margaritifera* und über die Ökologie ihres Wohnorts," *Arch. Hydrobiol.*, 1926, **17**, 423-91, 3 pls., 10 text-figs.). Material from the Regen River and its tributaries above Teisnach, in Eastern Bavaria, was used. Greatest development occurred in water deficient in lime, although in these waters the greatest injury occurred by corrosive action on the shell at the region of the umbones. This destruction of the shell is largely counteracted by the production of "oil spots" or "Tullberg's layers" of periostracum on the inner side of the shell. As successive layers of the shell are worn away, these lamellæ, which are more abundant in shells taken from lime-free waters, largely halt the advance of the destruction. A general correlation exists between rate of flow and shape of mussels. The slower the stream the higher and wider were the shells produced. The mussels migrated but little from their original station, the greatest distance being 22 metres up-stream during two years. Growth occurred during the summer months, especially during the breeding season, the growth rings formed being annual rings. Mussels of the same length differed materially in age and weight from the various streams and different areas of the same stream. Pearl production generally produces some malformation in the shell. Often a ridge is formed diagonally from the umbone. As the mussel grows, the pearl is carried forward with the mantle edge. The periostracum is pushed up in the form of a slight ridge. Deposition of the prismatic and nacreous layers does not take place in this ridge until after the pearl has been carried forward. Age of the pearls can

be determined by the number of annual rings crossed by the ridge. Other malformations in the shell (distortion, unequal valves, and lateral curvature) were often produced by pearl formation. Mantle regeneration takes place first by the production of periostracum between the mantle and the shell, leaving a small bubble-like area. As the injured area grows together, the succeeding layers are laid down. The bubble usually contains some organic material, in part from the mussel as well as that of foreign origin. The dark colour in pearls is due to the amount of organic matter incorporated within the pearl, such as the production of this layer of periostracum between the nacreous layers. Tables are given showing the percentage of dark colour proportionate to the amount of organic matter. A *résumé* is given of artificial pearl production, with a discussion of the difficulties. *Biological Abstracts.*

The Innervation of the Tentacles in Stylommatophorous and Basommatophorous Pulmonates.—B. HANSTRÖM ("Vergleich zwischen der Innervation der Fühler bei stylommatophoren und basommatophoren Pulmonaten," *Zool. Anzeiger*, 1926, **66**, 197–207, 4 text-figs.). The tentacles of the Stylommatophora (order Pulmonata, class Gastropoda) are much more complex structurally than those of the Basommatophora, as shown by the nerve supply and specialised sensory epithelium. The characters of the nerve endings in the tentacles of *Limnea* and *Planorbis* were studied by the Golgi method. A comparison was made between the brain structure of the two genera above-named and the Stylommatophora. The tentacular reflexes are discussed in relation to the innervation. The nerve supply of the tentacles of *Littorina littorea* and of *Neptunea* were similarly investigated. The author concludes that the presence of a tentacular ganglion and true sensory epithelium at the tip of the tentacle are directly correlated with life in air. *Biological Abstracts.*

The Absorption of Chinese Ink by the Gills of Acephalæ.—P. HATT ("L'absorption d'encre de Chine par les branchies d'acephales," *Arch. Zool. Exp. et Gen. Notes et Rev.*, 1926, **65**, 89–95, 4 text-figs.). In the Lamellibranchs (*Mytilus*, *Tapes*, *Ostrea*, *Gryphea*, *Mya*, and *Loripes*) the feelers and gills absorb China ink which had been added to their external medium. This absorption is direct, and not through the digestive apparatus. The grains become concentrated in the vacuoles of the gill cells and especially in the intercalary cells. In special ciliated cells the distribution seems to be influenced by the ciliary apparatus. Absorption is augmented by concentration. Accumulation of granules stimulates phagocytic leucocytes to action. Prolonged exposure to the ink medium initiates degeneration of the gills. *Biological Abstracts.*

Arthropoda.

Insecta.

Australian Butterflies.—G. A. WATERHOUSE ("Notes on Australian *Lycenidæ*, Part VI," *Proc. Linn. Soc. of N.S.W.*, 1928, **53**, 401–12, 1 pl.). Part V of these notes was published in these Proceedings for 1912, pp. 698–702, and during 1914 the "Butterflies of Australia," by Waterhouse and Lyell, in which the Australian *Lycenidæ* were thoroughly revised, was issued. Since 1914 only one new species has been described, but several new species have been found, and many important extensions of the ranges of known species require record. The localities given in this paper are additions to, or amendments of, those in the "Butterflies of Australia." M. E. M.

Australian Bombyliidæ.—F. H. S. ROBERTS ("A Revision of the Australian *Bombyliidæ* (Diptera), Part II," *Proc. Linn. Soc. of N.S.W.*, 1928, **53**, 413–55). The

characters of the sub-family *Bombyliidae* are described, and a key to the genera of this sub-family is provided. Similarly, the genus *Systæchus* Loew is described, and a key follows to the species of this genus. Among the numerous species dealt with, the following are the new species recorded:—*Systæchus rubidus* n. sp., *Systæchus albohirtus* n. sp., *Systæchus pallidus* n. sp., *Systæchus flavovillosus* n. sp., *Systæchus cinctiventris* n. sp. In the same manner the genus *Sisyromyia* White is described, and a key to the species is included. No new species of this genus is recorded. In the case of the genus *Anastæchus*, with its key to the species, the new species are *Anastæchus perspicuus* n. sp. and *Anastæchus annexus* n. sp. The genus *Bombylius* Linnæus is followed by a key to 14 species, of which *Bombylius proprius* n. sp., *Bombylius tenuirostris* n. sp., *Bombylius succandidus* n. sp., *Bombylius bellus* n. sp., *Bombylius dulcis* n. sp., *Bombylius pulchellus* n. sp., are the new records. Under the genus *Dischistus* Loew a key is given to the three new species, namely, *Dischistus formosus* n. sp., *Dischistus pallidoventer* n. sp., *Dischistus perparvus* n. sp.

M. E. M.

Studies on the Pink Bollworm.—S. S. BINDRA ("Studies on *Platyedra gossypiella* Saunders (Pink Bollworm) in the Punjab," Part I, *Mem. Dept. Agricul. in India*, 1928, 10, 167–216, 4 pls.). The first authenticated record of the occurrence of *Platyedra gossypiella* Saund. in the Punjab dates back to the year 1894, when two specimens were sent by the Director of Land Records and Agriculture, Punjab, to Merton, with the note: "Cotton boll-moths reared from caterpillars from Lahore." These specimens were identified as *Gelechia gossypiella* Saund. In 1917 Bainbrigge-Fletcher drew attention to the fact that *Gelechia gossypiella* Saund. occurs throughout the plains of India, Burma, and Ceylon as a pest of cotton, serious in many localities, especially so in the United Provinces, Punjab, and North West Frontier Province. In 1922 it was discovered by the Entomological Section, Punjab, that cottons in Sialkot and Ferozepore districts were badly attacked by *Platyedra gossypiella* Saund. On the appointment in 1923 of the author as the Indian Central Cotton Committee Scholar, detailed investigations of *Platyedra gossypiella* Saund. were started in the Punjab. 'So far, the work has been done along the following lines: Status and distribution of *P. gossypiella* in the Punjab. Seasonal history of *P. gossypiella* during the cotton season in S.E. Punjab. Resting-stage of "long-cycle" larvæ and emergence of "long-cycle" moths of *P. gossypiella*. The investigations have demonstrated that the attack of the pink bollworm differs at different times during the growing period of cotton. As compared with pink bollworm, the spotted bollworm is a minor pest in the S.E. Punjab. The number of pink bollworms infesting an attacked boll is one in August, one to five in September, one to six in October, one to ten in November, and one to nine in December. The attack of pink bollworm varies in *kapas* of different pickings; early and middle pickings are generally affected to a moderate degree, whilst late pickings are seriously damaged. A large number of pink bollworms pass the resting-stage in picked cotton. The caterpillars resting in seeds are mostly found in two-seeded chambers, a lesser number in three-seeded chambers, lesser still in single-seeded chambers, and least in four- and five-seeded chambers. The emergence of the moths, "short" and "long" cycle, of *Platyedra gossypiella* continues throughout the year except for a period of about ten weeks, from the 17th January to the 25th March.

M. E. M.

Drosophila under Aseptic Conditions.—H. M. STEINFELD ("Length of Life of *Drosophila melanogaster* under Aseptic Conditions," *Univ. Calif. Publ. in Zoology*, 1928, 31, 131–78, 8 text-figs.). The investigation was planned to test the

influence of certain selective agencies on length of life. The fruit fly *Drosophila melanogaster* was decided upon as the experimental animal, and the studies were limited to observations on the duration of life under aseptic and control conditions. The same strains of inbred flies were used for both the aseptic flies and the controls, and other environmental conditions were kept as nearly constant as possible. Five hundred flies of each of six strains in each part of the experiment were used. The start of aseptic flies was secured from eggs laid by the first sets of controls. These eggs were treated with a saturated solution of mercuric chloride in 70 p.c. alcohol for about seven minutes, and were later transferred to a medium consisting of 250 grams mashed banana, 250 c.c. water, 10 grams agar, 50 grams (4 cakes) Fleischmann's yeast which had been boiled for five minutes. The number of flies used in the experiments totalled over 25,000, and the following are the author's conclusions:—Aseptic larval-pupal life, followed by control conditions during the imaginal stage, increased the expectation of life of adult flies by 34.7 p.c. of the life-span in comparison with the first set of controls, and by 13.7 p.c. in comparison with the average of the two sets of controls. Sterilised banana agar is an inadequate food for aseptic *Drosophila* imagos, although the mean duration of life is higher than for the controls. On adequate food, banana agar and 10 p.c. yeast, *Drosophilas* reared throughout life under aseptic conditions have a greater mean duration of life than the controls by 18.04 days, 69 p.c. of the life-span. The life-curves of aseptic flies (plotted on the basis of 1,000) show a greater approach to the right-angle type than do the controls. Differential viability in the six strains of flies under aseptic conditions tended in large measure to be effaced. No uniformity was found with respect to differential sex mortality, though "yellow" shows a consistently greater expectation of life for the females and "cinnabar" for the males. The coefficients of variation show a progressive decline from the controls through indicated experiments.

M. E. M.

The Fertility of Silkworms.—E. POYARKOFF ("La formulæ de la fécondité chez le ver à soie du mûrier," *Compt. rend. de l'Académie des Sciences, Paris*, 1928, 187, 466-7). The difference between the dimensions and the form of the male and female cocoons of the silkworms is minute. The male and female cocoons are almost identical in these respects, and the weight of the silk puparium is practically the same in the cocoons of both sexes. The author states that it is possible, therefore, to claim that the cocoons are equal in all respects, except for one essential point, namely, that the weight of the female cocoons is noticeably greater than that of the male cocoons, this difference representing the weight of the necessary egg materials. If $C \text{ ♀}$ and $C \text{ ♂}$ equal the mean weights of the female and male cocoons among the different races of silkworms, P will represent the mean weight of the eggs carried by a single female, according to the following formula: $C \text{ ♀} - C \text{ ♂} = P$. A table is given which is said to support this contention.

M. E. M.

Australian Diptera.—J. R. MALLOCK ("Notes on Australian Diptera, XV," *Proc. Linn. Soc. of N.S.W.*, 1928, 53, pt. 4, no. 218, 319-35, 5 text-figs.). In the family *Sapromyzidae*, *Trigonometopus* (*Neotrigonometopus*) *albibasis* n. sp., *Homoneura* (*Homoneura*) *fergusoni* n. sp., and *Trypaneoides australis* n. sp. are described, while in addition certain notes are given on *Homoneura* (*Homoneura*) *pubiseta* Kertész. and *Homoneura* (*Homoneura*) *armata* Mallock. In the family *Sciomyzidae* a key to the genera of the tribe *Sepedonini*, a synopsis of the sub-genera of the genus *Dichatophora* Rondani, and a description of the sub-genus *Neosepedon* nov. with its representatives, *Dichatophora* (*Neosepedon*) *punctapennis* n. sp. and *Dichatophora*

(*Neosepedon*) *conjuncta* n. sp. are provided. Of the genus *Helosciomyza* Hendel, *Helosciomyza aliena* n. sp. is recorded and described. Some notes are given on the genus *Melina* Robineau-Desvoidy. In the family *Borboridæ* a description of *Leptocera* (*Collinella*) *trifascigera* n. sp. is given; in the family *Muscidæ*, *Atherigona bidentata* n. sp., *Limnina* nov. and the species *Limnina elongata* n. sp., together with *Limnella* nov., are described. In the family *Calliphoridae*, *Melinda minuta* n. sp. is described, and notes are provided on the genera *Melinda*, *Huttonobessoria*, *Pauorthinx*. In the family *Tachinidæ* there is a key to the genera of the tribe *Ameniini* with notes on the genus *Paramenia*, and its species, *Paramenia macularis* Walker. After an opportunity to examine the collection of the species of the tribe *Rutiliini* in the collections of the Deutsches Entmologisches Institut, the author is able to present data on many species previously unknown. A key to the species of the genus *Rutilia* is included. M. E. M.

A New Australian Buprestid.—A. THÉRY ("A New Buprestid from Australia," *Proc. Linn. Soc. N.S.W.*, 1928, 53, pt. 4, no. 218, 456-7, 1 text-fig.) *Mastogenius frenchi* n. sp. is described from four specimens from Victoria, Australia (captured by C. French). The type and a paratype are in the author's collection, one paratype in that of the British Museum, the other in Mr. H. J. Carter's collection. M. E. M.

Australian Diptera.—J. R. MALLOCK ("Notes on Australian Diptera, XVI," *Proc. Linn. Soc. of N.S.W.*, 1928, 53, pt. 4, no. 218, 343-56, 4 text-figs.). Discussing the family *Ortalidæ*, the author states that it occurs southward through the Orient to Australia, many of the species occurring in New Guinea, and five being recorded from Australia. A peculiar character of the genus *Euprosopia* Macquart is the haired basal section of the radius. This vein is very frequently setulose in *Ortalidæ*, but the setulæ are almost always confined to that section of the vein beyond the level of the humeral cross-vein. Other characters are discussed, and a key is provided for the identification of the eight species, three of which are new, namely, *Euprosopia macrotegularia* n. sp., *Euprosopia punctifacies* n. sp., *Euprosopia tegularia* n. sp. A key is provided for the identification of the species of the genus *Lamprogaster* Macquart, one of which is new, namely, *Lamprogaster indistincta* n. sp. In the genus *Elassogaster* Bigot one new species, *Elassogaster terræ-reginæ* n. sp., is described. An identification key is given to two species of the family *Ephydridæ*, genus *Brachydeutera* Loew, one of which, *Brachydeutera pleuralis* n. sp., is new. In the family *Drosophilidæ*, genus *Liodrosophila* Duda, a new species, *Liodrosophila australis* n. sp., is described. A key to 44 species of the family *Sapromyzidæ*, genus *Sapromyza* Fallen, is provided, one new species, *Sapromyza atrimana* n. sp., being recorded and described. Notes are given on the families *Calliphoridae* and *Stratiomyiidae*, with an identification key to the species of the sub-family *Beridinae*, genus *Neoxaireta* Osten-Sacken. A key is also provided to the sub-genera of the genus *Beris* Latreille, including seven sub-genera, one of which, *Berisina* n. gen., under which a new species, *Berisina maculipes* n. sp., is described and recorded. Notes are given on the genus *Metoponia* Macquart and its species *Metoponia rubriceps* Macquart, the paper being terminated by notes on the sub-family *Pachygastrinae* and the genera *Lonchæogaster* White and *Pachygaster* Meigen. M. E. M.

New Tipulidæ from Eastern Asia.—C. P. ALEXANDER ("New or Little-Known Tipulidæ from Eastern Asia (Diptera), III," *Philippine Journ. of Science*, 1928, 36, no. 4, 455-83, 2 pls.). The crane-flies discussed in the present paper were taken chiefly at high altitudes in the mountains of Formosa by Prof. Syuti

Issiki. Fewer were collected in Fukushimaken and Miyagiken, north-eastern Honshiu, Japan, by Prof. Issiki. This important series has added materially to our knowledge of the tipulid fauna of these two regions. A new species of *Paracladura* (*Trichoceridæ*) was represented in this collection. The author continues the discussion of the venational innovations from a previous part of this paper, and describes the following species:—Fam. *Trichoceridæ*, *Paracladura cuneata* sp. nov.; *Tipulidæ*, *Tipulinæ*, *Nesopeza trichopyga* sp. nov., *Tipula* (*Acutipula*) *lackeshewitziana* sp. nov., *Tipula nokonis* sp. nov., *Tipula sparsissima* sp. nov.; *Limoniinæ*, *Pediciini*, *Tricyphona orophila* sp. nov., *Rhaphidolabis* (*Rhaphidolabis*) *atripes* sp. nov.; *Limoniini*, *Orinarga pruinosa* sp. nov., *Dicranoptycha cæsia* sp. nov., *Hexatomini*, *Epiphragma nymphica* sp. nov., *Pseudolimnophila nokonis* sp. nov., *Limnophila* (*Tricholimnophila*) *excelsa* sp. nov., *Limnophila* (*Prionolabis*) *oritropha* sp. nov., *Eriocera issikii* sp. nov., *Elephantomyia* (*Elephantomyia*) *luculenta* sp. nov.; *Eriopterini*, *Gnophomyia laterospinosa* sp. nov., *Gonomyia* (*Ptilostena*) *pallens* sp. nov., *Gonomyia* (*Limophleps*) *ptilostenoides* sp. nov., *Gonomyia* (*Gonomyia*) *gilvipennis* sp. nov., *Dasymolophilus nokænsis* sp. nov., *Molophilus nigripes* Edwards., *Molophilus nokænsis* sp. nov., *Molophilus issikii* sp. nov., *Molophilus editus* sp. nov., *Ormosia diplotergata* sp. nov. M. E. M.

Australian Eriirhinides.—A. M. LEA ("New Species of Australian *Eriirhinides* (*Curculionidæ*)," *Proc. Linn. Soc. of N.S.W.*, 1928, 53, pt. 4, no. 218, 375–96). The species here dealt with are all small, but one of them (*Glaucopela nidicola*) is of special interest, as it was obtained in large numbers from a bird's nest in the arid district of Ooldea. The following is a list of the new species described:—*Glaucopela nidicola* n. sp., *Desiantha ferruginea* n. sp., *Desiantha curvisetosa* n. sp., *Desiantha inermis* n. sp., *Desiantha tribitticollis* n. sp., *Desiantha foveata* n. sp., *Desiantha humeralis* n. sp., *Desiantha alpina* n. sp., *Desiantha longa* n. sp., *Desiantha albidosparsa* n. sp., *Desiantha puncticollis* n. sp., *Desiantha mucronata* n. sp., *Desiantha parvonigra* n. sp., *Desiantha metallica* n. sp., *Desiantha stenoderes* n. sp., *Desiantha parviocornis* n. sp., *Desiantha lata* n. sp., *Desiantha rostralis* n. sp., *Cydmæa nasalis* n. sp., *Cydmæa internixta* n. sp., *Cydmæa basalis* n. sp., *Cydmæa sordida* n. sp., *Cydmæa latirostris* n. sp., *Cydmæa leucomela* n. sp., *Cydmæa vitticollis* n. sp., *Cydmæa inconstans* n. sp., *Cydmæa subuniformis* n. sp., *Cydmæa multimaculata* n. sp., *Cydmæa monobia* n. sp., *Cydmæa indestructa* n. sp., *Cydmæa exilis* n. sp., *Cydmæa soror* n. sp., *Cydmæa scutellaris* n. sp., *Cydmæa cordipennis* n. sp., *Cydmæa ænula* n. sp., *Cydmæa metasternalis* n. sp., *Cydmæa viridis* n. sp., *Cydmæa murina* n. sp., *Cydmæa setipennis* n. sp., *Cydmæa interocularis* n. sp., *Cydmæa gennea* n. sp. M. E. M.

Biology of the "Blister-Mites."—A. S. HASSAN ("The Biology of the *Eriophyidæ*, with Special Reference to *Eriophyes tristriatus* (Nalepa)," *Univ. of Calif. Publ. Ent.*, 1928, 4, no. 11, 341–94, pls. 9–14, 14 text-figs.). The author describes a technique by which the handling and study of the mites is facilitated. The results of the present study, it is hoped, will enable collectors and taxonomists to know the species of the family *Eriophyidæ* not only by their work on plants, as heretofore, but also by the characteristics of the organisms themselves. The literature of the "blister-mites" is widely scattered in various publications, and an endeavour has been made to bring together some of the references which would be of value to the taxonomist. The author also includes a classification down to the genera, and a short discussion regarding specific characters in relation to the description of new species. Four new species of "blister-mites" have been described and are appended to this paper. Three species belong to the genus

Eriophyes and one to the genus *Phyllocoptes*. The biology and morphology of the black walnut "blister-mite," *Eriophyes tristriatus* (Nalepa), as well as its relation to gall-formation, have been studied. The results of an attempt to study the embryonic and post-embryonic developments of this mite have also been recorded. These results, however, are by no means complete because of the many handicaps which were met with in the course of the investigations. The mites are extremely minute, live in seclusion in galls, and the same individuals cannot be adequately observed continuously in the laboratory even on their host-plant. This species was taken to represent the family because of its availability. It has been found abundantly at Davis, California, where part of the work was done in the entomological laboratory of the University of California during the spring of 1927.

M. E. M.

The Classification of the Australian Asilidæ.—G. H. HARDY ("Third Contribution towards a New Classification of the Australian *Asilidæ*," *Proc. Linn. Soc. of N.S.W.*, 1928, 53, pt. 4, no. 218, 469-73). About eighty years ago Loew laid the foundation for a classification of *Asilidæ*, with three sections of sub-family rank; to these a fourth was added by Schiner. Various writers have classified the *Asilidæ* on this basis, either accepting or disregarding the fourth family, *Leptogasterinæ*. Several authors have pointed out the impossibility of maintaining a distinction between *Dasypogoninæ* and *Laphriinæ* under the existing definitions, whilst others have apparently been satisfied with their status. Some of the more recent works have incorporated a study of the larvæ and pupæ, and along these lines Melin seems to have achieved the nearest to a constructive criticism of the position. Melin's criticism, based as it is upon biological grounds, after about ten years of intensive study, must bear greater weight than any criticism levelled against it on general grounds, and to a great extent the author considers that it justifies his action in gathering together the related Australian genera, showing affinities to each other, into groups, these groups being based upon characters of a fundamental nature rather than those that have been so long accepted in the systems adopted after Loew, and which are found so futile for the Australian element. With the present paper will be found a study of the prothorax of the *Dasypogoninæ*, this structure having a character of tribal importance. It has enabled the author to propose a new tribe, which, though defined, is left unnamed pending further information. Following on Hermann, the tribe *Laphriini* is divided also. In this paper the author describes the following new species:—*Cryptopogon obscurus* n.sp., *Chryseutria nigrinus* n.sp.

M. E. M.

The Tracheal Gland of Insects.—M. SAKURAI ("Sur la glande trachéale des quelques insectes," *Compt. rend. de l'Acad. des Sci.*, 1928, 187, 614-15). By a previous investigation the author has studied the tracheal gland of the silkworm in collaboration with M. Ishiwata. The present investigation was undertaken with the object of determining its presence or absence in other insects. The insects examined were certain species of *Lepidoptera*, *Hymenoptera*, *Hemiptera*, and *Coleoptera*. The presence of the gland was observed in some of the species belonging to the *Lepidoptera* and *Hymenoptera*, but the author was not able to reveal its presence in the case of the *Hemiptera* and the *Coleoptera*. He concludes that the function of the tracheal gland is to facilitate the ecdysis of the tracheæ. A short description of the general form and morphology of the gland and an outline of its position within the bodies of different insects are given. It is stated, however, that the gland is sometimes absent even in the larvæ of certain species of *Lepidoptera* and *Hymenoptera*.

M. E. M.

Hymenoptères vespiformes of France.—L. BERLAND ("Faune de France : *Hymenoptères vespiformes*, II," *Office Central de Faunistique, Paris*, 1928, 19, 1–208, 232 text-figs.). This volume comprises a study of the *Hymenoptera Vespoides* of France. The book is conveniently arranged, and is an admirable addition to the literature of hymenopterists. A short account of the morphology and the external anatomy is followed by a brief account also of the bionomics and habitats of this group. Some information on the food-supply of the larvæ and the paralysis of the prey forming the larval food-supply is subsequently given, and with a short key by which the sexes of this group may be recognised, the author proceeds to the main part of his work. Seventy-two pages are devoted to an account of the *Eumenidæ* and its species, fourteen pages to the *Vespidæ*, four to the *Masaridæ*, forty-one to the *Bethylidæ*, thirty-two to the *Dryinidæ*, and finally four pages to the *Embolemidæ*. Ten pages are later given to "Additions and Corrections," and the book concludes with thirteen pages of references to the literature and a fairly complete specific index. M. E. M.

Australian Tanyderidæ.—C. P. ALEXANDER ("The *Tanyderidæ* of Australia (Diptera)," *Proc. Linn. Soc. of N.S.W.*, 1928, 53, pt. 4, no. 218, 367–74, 4 text-figs.). The remarkable paleogenic group of *Diptera* now included in the family *Tanyderidæ* is represented by 10 recent and fossil genera totalling slightly more than a score of species. Of this number, three genera with four species are herein recorded from the Australian sub-region. For many years the flies of this group were included in the family *Tipulidæ*, where they were ranked as a distinct tribe or placed with the *Ptychopterini*. More recently the various Tanyderid genera were distributed in the *Ptychopteridæ*. The group was finally accorded full family rank by Alexander. A key to the genera of the *Tanyderidæ* is given, and among the many species described the following is a new genus and species, *Eutanyderus* n. gen., *Eutanyderus wilsoni* n. sp. M. E. M.

New Australian Ants.—F. SANTSCHI ("Nouvelles Fourmis d'Australie," *Bull. de la Soc. Vaudoise des Sciences Naturelles*, 1928, 26, no. 221, 465–83, 2 text-figs.). The following new species and new varieties are described:—*Myrmecia* (*Pristomyrmecia*) *regina* n. sp., *Myrmecia* (*Pristomyrmecia*) *piliventris*, Sm. var. *fenorata*, n. var., *Pseudoponera* *chelifer* n. sp., *Monomorium* (*Lampromyrmex*) *fraterculus* Sants. var. *barretti*, n. var., *Meranoplus* *barretti* n. sp., *Meranoplus* *aerolus* Crawl. st. *linæ*, n. st., *Meranoplus* *aerolus* Crawl. st. *doddi*, n. st., *Meranoplus* *hirsutus* Mayr. st. *minor* For. var. *bimaculatus* n. var., *Iridomyrmex* *biconvexus* n. sp., *Iridomyrmex* *gracilis* Lown. *rubriceps* For. var. *linæ*, n. var., *Tapinoma* (*Micromyrmex*) *minutum* Mayr. var. *cephalicum*, n. var., *Tapinoma* (*Micromyrmex*) *indicum* For. var. *timidum*, n. var., *Tapinoma* (*Micromyrmex*) *melanocephalum* Mayr. var. *lustrale*, n. var., *Melophorus* *constans* n. sp., *Stigmacros* *barretti* n. sp., *Paratrechina* (*Nylanderina*) *nana* n. sp., *Paratrechina* (*Nylanderina*) *minutula*, For. var. *buxtoni*, n. var., *Camponotus* (*Myrmoturba*) *latrunculus*, Wheel. var. *victoriensis*, n. var. M. E. M.

New Philippine Chalcids.—A. A. GIRAULT ("Some New Philippine Chalcid Flies," *Philippine Journ. of Science*, 1928, 36, no. 4, 449–53). The types of the following species are in the Queensland Museum, Brisbane, and the whole of the material was collected by Professor C. F. Baker. The species resemble Australian forms—*Cleonyminæ*, *Thaumasurelloides* *silvæ* Girault; *Eupelminæ*, *Calosota* *splendida* Girault, *Eupelmus* *cooki* Girault; *Eucyrtinæ*, *Anagyrodus* *punctaticeps* sp. nov.; *Megastigminæ*, *Bootanomyia* *gemma* sp. nov.; *Eucharitinæ*, *Parapsilo-*

gaster montanus sp. nov.; *Parapsilogaster striatus* sp. nov., *Chalcura glabra* sp. nov., *Kapala fasciatipennis* sp. nov., *Kapala foveatella* sp. nov. Descriptions are given of these new species. M. E. M.

A Californian Species of Japyx.—F. SILVESTRI ("Description of a New Species of *Japyx* (*Thysanura*) from Potter Creek Cave, Shasta County, California," *Univ. of Calif. Publ. Ento.*, 1928, 4, no. 10, 335–40, 3 text-figs.). This interesting species of *Japyx* is very distinct among the previously described species in that it has the posterior angles of the abdominal tergites 5–8 produced behind, and differs also from the other North American species because of the number of antennal segments, the character of the forceps, and the simple non-pectenate first appendage of the internal lobe of the first maxilla. The present paper describes this new species under the name of *Japyx kofoidi*. The specimens were collected in 1903, and the species is stated to be by far the largest known from California.

M. E. M.

New Chalcidoid Parasites from Africa and California.—H. COMPERE ("New Coccid-inhabiting Chalcidoid Parasites from Africa and California," *Univ. of Calif. Publ. Ento.*, 1928, 4, no. 8, 209–30, pls. 6–8). In this paper three genera and eight species of chalcidoid parasites reared from coccids are described as new, and types of the species have been deposited in the U.S. National Museum. One species, *Microterys claripennis* n. sp., is commonly reared from *Eulecanium corni* Bouche, a serious pest of deciduous fruit trees. *Neococcidencyrtus alula* n. gen. and n. sp. is a fairly effective parasite of *Diaspis zaniae* Morg. However, this coccid is relatively unimportant, as it is only known to attack cycads. Nothing is known of the status of *M. claripennis*. The author gives full descriptions of these eight new species and the three new genera.

M. E. M.

Insect Parasites of the Black Scale.—H. S. SMITH and H. COMPERE ("A Preliminary Report on the Insect Parasites of the Black Scale, *Saissetia oleæ* Bernard," *Univ. of Calif. Publ. Ento.*, 1928, 4, no. 9, 231–334, 63 text-figs.). The black scale, *Saissetia oleæ* Bernard, is generally recognised in California as the pest of first importance to both the citrus and olive industries. Growers of these two products are annually subjected to an expense of many hundreds of thousands of dollars for its control, to say nothing of the damage done to fruit and trees, and the expense of washing the fruit from infested orchards to prepare it for the market. Also, during more recent years, there appears to be a gradual lessening of the effectiveness of cyanide fumigation against the black scale, which is occasioning some alarm on the part of the growers concerned. As a foundation to adequate control measures, a thorough knowledge of the distribution of the parasites of the black scale, their life-histories and habits, and their ecological relationships, is necessary. This paper is designed to place on record our present knowledge bearing on the parasites of the black scale. The authors state that the predatory enemies are to receive treatment in a later publication.

M. E. M.

Arthropoda.

Arachnida.

Spiders from the Congo.—R. DE LESSERT ("Araignées du Congo recueillies au cours de l'expédition organisée par l'American Museum (1909–1915), deuxième partie," *Revue Suisse de Zoologie*, 35, no. 3, 303–52, 29 text-figs.). Descriptions of the following genera and species are given, with notes on the habitats of most:—Fam. *Thomisidae*, gen. *Simorcus*, Simon 1895, *Simorcus coronatus*, Simon

1907; gen. *Dieta*, Simon 1880, *Dieta argenteo-oculata*, Simon 1886; gen. *Hewittia* n. gen., *Hewittia gracilis* n. sp.; gen. *Tmarus*, Simon 1875, *Tmarus bedoti* n. sp., *Tmarus mallei*, Lessert 1919, *Tmarus berlandi* n. sp., *Tmarus foliatus* n. sp.; gen. *Monæses*, Thorell 1869, *Monæses pustulosus*, Pavesi 1895 (?); gen. *Platythomisus*, Dolecschall 1859, *Platythomisus insignis*, Pocock 1899; gen. *Thomisus*, Walckenaer 1805, *Thomisus weberi*, Lessert 1923; *Runcinia*, Simon 1875, *Runcinia depressa*, Simon 1906, *Runcinia æthiops*, Simon 1901; gen. *Synæma*, Simon 1864, *Synæma bragantium*, Brito Capello, 1868, *Synæma reimoseri* n. sp., *Synæma (Firmicus) campestratum*, Simon 1907, sub-sp. *faradjensis* n. sub-sp., *Synæma (Firmicus) multipunctatum*, Simon 1895; gen. *Tibellus*, Simon 1875, *Tibellus vossioni*, Simon 1884, sub-sp. *armata* n. sub-sp.; fam. *Pisauridæ*, gen. *Euprosthénops*, Pocock 1897, *Euprosthénops bayaoniamus*, Brito Capello 1867 (?), *Euprosthénops pavesii* n. sp., *Euprosthénops armatus* Strand, sub-sp. *garambensis* n. sub-sp.; gen. *Tetragonophthalma*, Karsch 1878, *Tetragonophthalma simoni*, Lessert 1916; gen. *Rothus*, Simon 1898, *Rothus faradjensis* n. sp.; gen. *Pisaura*, Simon 1885, *Pisaura ducis*, Strand 1913 (?); gen. *Cispus*, Simon 1898, *Cispus (?) minor* n. sp.; gen. *Thalassius*, Simon 1885, *Thalassius guineensis*, Lucas 1858, *Thalassius guineensis* Lucas, var. *annulata* n. var.; gen. *Dolomedes*, Letreille 1804, *Dolomedes carosbyi* n. sp., *Dolomedes gracilipes* n. sp. M. E. M.

Crustacea.

Studies of *Arbacia punctulata* and Allies and of Non-Pentamerous Echini.—R. T. JACKSON (*Mem. Boston Soc. Nat. Hist.*, 1927, 8, 433-565, 75 text-figs). The importance is urged of a combined study of recent and fossil forms of a group. Echini are an exceptionally favourable group in which to study variation on account of their definite structure, largely on a numerical basis, and their good representation in both the recent and fossil faunas. A classification of variation is considered as an aid to systematically locating variants. It is found that in Echini variations are mostly on definite lines of departure from the typical. Of *Arbacia punctulata* from Woods Hole, Massachusetts, 14,100 were measured, divided into 5 mm. lots, and studied. A study of a large series gives one a grip that nothing else will on what is the normal character, the age at which definite characters are introduced, the range of variation, and the relative frequency with which rare characters occur. In preparing specimens, excellent results were obtained by rinsing new material in fresh water, then soaking for 12 hours in a 1:1000 solution of corrosive sublimate and drying in sun or airy place. This preserves all the parts intact and retains the original colour, making excellent museum specimens. Ocular plates enter the periproct, or become insert, very slowly in *A. punctulata*. The adult character by a small margin at Woods Hole is for ocular V alone to be insert. Those with all oculars exsert are considered arrested variants, or those with I, V, or I, V, IV, or I, V, IV, II insert are considered progressive variants. Oculars in the Arbaciidæ become insert in the sequence V, I, IV, II. The placogenous zone from which coronal plates develop exists at the adoral border of ocular plates. Ocular plates may meet across the adoral border of genitals, cutting them off from contact with the corona. Extra genital pores are unusually frequent in *Arbacia*. Genital pores may exist in ocular plates or in interambulacral plates. A genital plate may be absent, or an extra one may be added, without otherwise affecting the skeleton. While genital plates are usual, they are not necessary to a functional genital gland or to a complete development of the corona. In *Arbacia* there are typically 4 plates in the periproct. As variations there may be only 3 or 2, or more than 4 up to 50 have been found.

Primordial interambulacral plates are retained in the basicoronal row in *Arbacia* and all other genera of the family, a character otherwise known in recent regular Echini only in the Echinothuridae. In *Arbacia* increase in size of the test is attained mainly by the increase in size of plates rather than by the addition of new plates. Increase in size of the peristomal opening in Echini is attained by resorption of the base of the corona, or by the growth of plates, or by both. Growth of plates is shown to be by far the more effective method. As variation from the pentamerous system, 64 specimens are described that have not been previously recorded. In addition, a review is given of those found in literature. In all, 213 non-pentamerous variants are recorded. Of these, 201 are included in some one of the 32 groups defined, 12 are located in *incertæ sedis*; of those grouped, 34 p.c. are included in 2 groups, over half, or 57 p.c., are included in 4 groups, and 81 p.c. are included in some one of 10 groups, demonstrating the definiteness of even such aberrant variants.

Biological Abstracts.

The Morphology of Euryalæ.—D. M. FEDOTOV ("Die Morphologie der Euryalæ," *Ztschr. Wiss. Zool.*, 1926, 127, 403–528, 83 text-figs.). This is a detailed account of the morphology of representatives of the families Gorgonocephalidae and Trichasteridae based on critical studies on *Gorgonocephalus eucnemis*, *G. arcticus* and *Astrocladus coniferus* and vars. *paradalis* and *dofleini* (Gorgonocephalidae); and *Astroschema* (*Ophiocreas*) sp., and *Euryale aspera* (Trichasteridae). A series of typical ophiurans was also studied, among others *Ophioscolex glacialis* and *Ophionotus* (*Ophioglypha*) *hexactis*. The author first reviews the work previously done on the morphology of the Euryalæ and then takes up the structure of *Gorgonocephalus eucnemis*, describing in great detail integument and musculature, skeleton, nervous system, gut, ambulacral system, blood vascular system, axial organ complex, secondary body cavity, bursæ or tertiary body cavity, genital cord, genital sacs, and excretion. The external and internal growth changes are now described, based on both *G. eucnemis* and *G. arcticus*, and the biology, especially the choice of localities and habitats and the planktonic feeding habits, is taken up in detail. The association of the young of *Gorgonocephalus* with alcyonarians (*Gersemia*) and the general association of Euryalæ with alcyonarians of various sorts is described. The structure of *Astrocladus* is given. This is followed by a critical summary of the previous literature on the Gorgonocephalidae and a delineation of the general features of the family. Taking up the Trichasteridae, the author describes *Astroschema* (*Ophiocreas*) sp. in detail, taking up the gut, nervous system, ambulacral system, blood vascular system, secondary body cavity, bursæ or tertiary body cavity, genital cords and genital sacs. This is followed by some notes on the anatomy of *Euryale aspera*, and critical comments on the previous literature on the family Trichasteridae, general remarks on the family, and a comparison of the families Gorgonocephalidae and Trichasteridae. Fossils which have been assigned to the Euryalæ (*Eucladia*, *Euthemon*, *Onychaster*) are considered in detail. The essential points in the organisation of the Euryalæ are contrasted in tabular form with those in the typical ophiurans, and a critical review of the systematic position of the group as understood by previous authors is given. The author is of the opinion that the Euryalæ are sharply distinguished from all the other ophiurans.

Biological Abstracts.

An Ophiuran from the Werfen Beds of the Dolomite (Trias).—Ä. NÖTH ("Über Ophiurenreste aus den Werfener Schichten der Dolomiten," *Centralb. Min. Geol. u. Palæont. Abt. B*, 1927, 426–32, 3 text-figs.). The ophiurans are found near Mount Forca in a layer of red marl of the Werfen beds containing

the index fossil *Pseudomonotis clarei* of the Upper Werfen (Lower Triassic or Skytian). Three specimens were found, two showing the dorsal and one the ventral side; further search revealed only fragments of arms. The specimens, which are described, are probably to be referred to *Ophiderma squamosum* Ben.

Biological Abstracts.

On the Statocysts of *Astacus fluviatilis* L.—A. PANNING ("Über die statocyste des *Astacus fluviatilis* L.," *Mitteil. Zool. Staatsinst. u. Zool. Mus. Hamburg*, 1926, 42, 118–25, 4 text-figs.). The author revises certain earlier remarks upon the structure of the sensory and guard hairs of the crustacean statocyst, as well as those of the basal joint of the antennules, finding further support for his belief in their common origin. Observations tending to corroborate his views on the interpretation of the structure of the statocyst glands are included.

Biological Abstracts.

Development of the Male Gonopods and Life-History of a Polydesmid Millipede.—H. H. MILEY (*Ohio J. Sci.*, 1927, 27, 25–41). *Euryurus erythropygus* (Brandt) was studied, attention being given also to certain anatomical features, copulation, oviposition, characteristics of eggs and post-embryonic development. The post-embryonic development involves (1) 7 ecdyses, occurring in hollow, somewhat spherical chambers or cocoons, and (2) an increase in size and addition of segments and legs. The time required for ecdysis increases with each later larval stage. The gonopods of the ♂ millipede are modified from the 8th legs, which occur on the 7th body segment. Males of the 3rd instar possess 11 pairs of legs, as also do the ♀. In the ecdysis between instars 3 and 4, the 8th pair is lost and the rudiments of the gonopods appear in the 4th instar. Individuals of instar 3 with somewhat reduced 8th legs were thought to be ♂. In the next ecdysis the 8th legs are replaced by 2 very small appendages. The 5th instar shows a small oval disc with 2 joints of each gonopod indicated. After the next moult, 3 joints are present and the oval disc is larger. In the last instar these appendages are free from the sternite and lie in an oval opening in it. By the breaking away of the wall on the inner proximal corner of the 3rd joint, accompanied by straightening, the adult distal joint is produced.

Biological Abstracts.

Tetraploidy and Gigantism: a Comparison of Post-Embryonic Stages of Diploid and Tetraploid *Artemia Salina*.—C. ARTOM ("Tetraploidismo e gigantismo. Esame comparativo degli stadi postembrionali dell' *Artemia salina* diploide e tetraploide," *Internat. Rev. Ges. Hydrobiol. u. Hydrograph*, 1926, 16, 51–80, 3 pls., 15 text-figs.). The author previously defined two groups of *A. salina*, "micropireniche," which has a diploid number of chromosomes and reproduces sexually; "macropireniche," which has a tetraploid number and reproduces parthenogenetically. He thinks that these two may be regarded as distinct species (not named) for biological and morphological reasons. (a) Structural: The cells in the tetraploid specimens are uniformly larger than in the diploid; this applies to the cells of all stages, from the eggs to the tissues of the adults. The gigantism of the cells is definitely correlated with tetraploidy, and is a fixed and immutable character. Tetraploid specimens have a rectangular cephalic outline, diploid specimens a rounded outline. Tetraploid specimens at times may be smaller in size than diploid specimens, a condition that is comparable to *Enothera gigas nanella* and the form *nana*. (b) Biological: During development certain structures of tetraploid specimens appear precociously, much earlier than in similar stages of diploid specimens; this includes the otic ganglia, the median eye, and the lateral eyes.

Biological Abstracts.

Observations on the Determinism of the Spicular Form in the Pluteus Larvæ of Sea-Urchins.—M. PRENANT ("Contributions à l'étude cytologique du calcaire. III. Observations sur le déterminisme de la forme spiculaire chez les larves pluteus d'oursins," *Bull. biol. France et Belgique*, 1926, **60**, 522-60, 16 text-figs.). The larval spicules are secreted by mesenchyme cells cytologically very similar to those which form the sea-urchin tooth. In *Paracentrotus lividus* and *Psammechinus miliaris*, some time prior to calcification, the exoplasm of certain mesenchyme cells anastomoses to organise three fundamental tracts: (a) a ring round the blastopore and (b) two longitudinal tracts. At the points of junction of (b) with (a) the first two triradiate spicules are laid down. In *Echinocardium cordatum* additional tracts—the forerunners of the recurrent rods and of the aboral skeletal piece—appear at a somewhat later period. A series of experiments was undertaken to find out (1) the effect of glycerine, sulphuric acid, potassium chloride and lithium bromide on the development of the skeleton, and (2) the time of determination of the spicular form. Once the tracts are formed, calcification may be delayed, but the skeleton is always of the normal type. If the early organisation of the mesenchyme is interfered with so that variations in the tracts arise, then corresponding variations in the skeleton result. The forces of crystallisation do not enter into the determination of the triradiate spicule, which is determined entirely by the disposition of the mesenchymatous anastomoses.

Biological Abstracts.

The Cladocera of Lake Muskoka in Ontario, Canada.—F. B. ADAMSTONE (*Trans. Am. Micr. Soc.*, 1928, **47**, 460-63). Thirty-nine species of Cladocera were found; all, with the exception of *Chydorus bicornutus* and *C. ovalis*, have been encountered in other parts of Ontario. During the summer months there is a regular succession of limnetic species.

G. M. F.

The Musculature of *Pandalus danæ* Stimpson.—A. A. BERKELEY (*Trans. Roy. Can. Inst.*, 1928, **16**, 181-232, 8 pls.). *Pandalus danæ* Stimpson, the commonest form of edible prawn found in the neighbourhood of Vancouver Island, B.C., is compared with *Astacus*, more especially as regards the musculature.

G. M. F.

Annulata.

Castration in the Earthworms Does Not Prevent Development of the Secondary Sexual Characters Anatomically or Physiologically.—MARCEL AVEL (*Compt. rend. de l'Acad. des Sci.*, 1928, **187**, 67-9). The experiments on partial and total castration of earthworms, described by the author in a previous communication, have been continued and extended, and have resulted in a complete confirmation of the earlier conclusion that, both anatomically and physiologically, the secondary sexual characters are developed independently of the genital organs and not under their influence.

J. L.

Nemathelminthes.

The Life-Cycle of *Heterakis*.—H. P. DORMAN ("Studies on the Life-Cycle of *Heterakis papillosa* Block," *Trans. Am. Micr. Soc.*, 1928, **47**, 379-413, 1 pl., 10 text-figs.). The life-cycle of this chick nematode is direct. The host may be infected by the ingestion of eggs which have undergone a period of incubation outside any organism, and adult worms, capable of producing eggs, may be recovered in the cæca, the natural seat of infestation. The ingestion of larvæ does not produce infection, which shows that hatching must occur within the definitive host. Infective hatching occurs posterior to the gizzard.

G. M. F.

Platyhelminthes.

Cestoda.

Larval Cestodes in the Liver of the Sunfish.—E. LINTON ("Larval Cestodes (*Tetrarhynchus elongatus* Rudolphi) in the Liver of the Pelagic Sunfish (*Mola mola*) collected at Woods Hole, Mass.," *Trans. Am. Micr. Soc.*, 1928, 47, 464-7, 1 pl.). In all molas examined, the liver contained examples of larval cestodes; in all cases also the plerocerci had grown to a great length. There is no indication that larvæ which have become established in the liver of mola ever reach the species of shark which is their proper final host. G. M. F.

Cestodes of Brazilian Mammals.—J. G. BAER (*Abhandl. d. Senckenb. Naturf. Ges.*, 1927, 40, 377-86, 10 figs.). The material collected by Prof. Bresslau, and which is described by the author in this paper, consists of 10 species, 3 of which are new. Six new hosts are recorded. The new species are:—*Diphyllbothrium bresslaui* from *Didelphys aurita* (this is the first record of this genus in a marsupial); *Diphyllbothrium gracile*, which is peculiar in that its segments are always longer than broad; and *Hymenolepis cebidarum*. This species differs from *Hymenolepis diminuta* in the absence of a rostellum, in having a longer neck and a larger, spherical egg. A complete list of cestodes from South American mammals is appended. J. L.

Brazilian Cestodes of Reptiles and Birds.—O. FUHRMANN* (*Abhandl. d. Senckenb. Naturf. Ges.*, 1927, 40, 389-401, 21 figs.). Although the cestode fauna of Brazil is very well known, the author found only one hitherto described species in this group of material collected by Prof. Bresslau. Four new species are described from reptiles: *Ophiotaenia jarara*, *Ophiotaenia elongata*, *Oochoristica bresslaui*, and *Oochoristica braziliensis*. Two are from birds: *Anonchotaenia braziliense* and *Culcitella bresslaui*. J. L.

Trematoda.

Parasitic Worms of Hawaiian Chicks.—J. E. GUBERLET ("Parasitic Worms of Hawaiian Chickens, with a Description of a New Trematode," *Trans. Am. Micr. Soc.*, 1928, 47, 444-51, 1 pl.). Owing to the isolation of the Hawaiian Islands, it has been thought that light might be thrown on the origin of the fauna by a study of the relationships of the parasites harboured by the prevailing animals. One trematode found parasitic in Hawaiian chickens is a common inhabitant of hens in Northern Africa, Russian Turkestan, and Indo-China. The cestodes found were *Davainea cesticillus* Molin., *D. tetragona* Molin., *Choanotaenia infundibuliformis* Goeze, and *Hymenolepis Carioca* Magalhaes. The nematodes were represented by *Ascaridia perspicillum* Reed and *Heterakis papillosa* Block. *Oxyspirura mansonii* Cobbold was found in two cases. *Harmostomum hawaiiensis* is described as a new species owing to the fact that the excretory pore opens to the exterior on the dorsal surface at some distance from the posterior end. G. M. F.

The Trematode Family Strigeidæ.—R. C. HUGHES ("Studies on the Trematode Family Strigeidæ (Holostomidæ). No. XIII. Three New Species of Tetracotyle," *Trans. Am. Micr. Soc.*, 1928, 47, 414-34, 1 pl.). The three new species described are *Tetracotyle communis* sp. nov., which was obtained from *Stizostedion canadense griseum* De Kay., caught from Lake Erie; *T. intermedia* sp. nov., from *Prosopium quadrilaterale* Richardson, from Lake Huron, and *T. diminuta* sp. nov., from *Perca flavescens*, from Wampler Lake, Michigan. G. M. F.

Trematode Parasites of Philippine Vertebrates.—MARCOS A. TABANGUI (*Phil. Journ. Sci.*, 1928, 36, 351-71, 5 pls.). The parasites from vertebrates, other than man and the domestic animals, described in this paper were collected in the region of Los Banos, Laguna Province, Kuzon, Philippine Islands. They are arranged for convenience under hosts. Of the 14 species described and figured, 11 are new to science. There is one new genus, *Postorchigenes*. J. L.

Larval Trematodes from Philippine Snails.—MARCOS A. TABANGUI (*Phil. Journ. Sci.*, 1928, 36, 37-54, 5 pls.). The larval trematode fauna of the Philippines had not been investigated previously, and the object of the present work has been to add to the recorded fauna of the islands, and to form the basis of future attempts to elucidate the life-history of some of the Philippine flukes. Common freshwater snails of four species in all were examined, three of which, *Melania* sp., *Melania asperata philippinensis* Sowerby, and *Ampullaria lagunensis* Baitsch, were found to be infected. Nine species of cercaria were recovered from these snails, and are described and figured in the plates which follow. J. L.

Porifera.

Note on the Inclusion of Sand in Sponges.—M. E. SHAW (*Ann. and Mag. Hist.*, 1927, 19, 601-9). The inclusion of sand and foreign spicules is especially common in species with a considerable amount of spongin occurring in the shallow water of the warmer seas and in which the proper spicular skeleton is much reduced. The foreign spicules are not absolutely confined to the spongin fibres. Sand may be plentiful in the neighbourhood and yet none be taken in by the sponges. The inclusions seem to be carried by amœbocytes to the spongin fibres and given a definite orientation therein. While as yet no definite causes for the intake of sand and spicules can be stated, the process is probably not a chance occurrence, but adaptive in that it provides for some physiological need.

Biological Abstracts.

Protozoa.

The Cytology of *Trachelomonas volvocina*.—C. N. WILSON ("The Cytology and Reproduction of the Flagellate *Trachelomonas volvocina*, *Trans. Am. Micr. Soc.*, 1928, 47, 2 pls., 5 text-figs.). The method of reproduction in *Trachelomonas volvocina* was found to be a process of binary fission which takes place after the organism has left its test. Nuclear division appears to be similar to that in *Euglena agilis*. Both rod-shaped and granular mitochondria are often present, but in some cases only rod-shaped ones are found. The hypothesis of Causey that the shape of mitochondria is an index to their function in metabolism cannot be applied to the euglenoid flagellates as a group until further evidence is produced.

G. M. F.

Morphology of *Pyrsonympha*.—W. N. POWELL ("On the Morphology of *Pyrsonympha*, with a Description of Three New Species from *Reticulitermes hesperus* Banks," *Univ. Calif. Publ. Zool.*, 1928, 31, 179-200, 3 pls., 4 text-figs.). *Pyrsonympha minor* sp. nov., *Pyrsonympha granulata* sp. nov., and *Pyrsonympha major* sp. nov. occur in the intestine of the termite *Reticulitermes hesperus* Banks both free in the lumen and attached to the intestinal wall. The flagellar cords arise from the anterior centropharynx and run backwards in a leiotropic spiral about the body to end as free flagella posteriorly. Adult individuals have eight flagellar cords; young, recently divided forms four flagellar cords. The nucleus contains a linin network in which are embedded fine granules of chromatin

and an endosome which is a true nucleolus since it disappears at mitosis without taking any part in chromosome formation. Pyrsonympha seems to be related to the trichomonad flagellates in regard to the nature of the axostyle and the possible homology of the flagellar cords with the marginal filament of the undulating membrane in *Trichomonas*. Pyrsonympha belongs to the order Polymastigina.

G. M. F.

The Macronucleus of *Chilodon uncinatus*.—E. F. GALIANO ("Observaciones sobre el macronúcleo de *Chilodon uncinatus* Ehrbg.," *Bol. de la real Soc. españ. de Hist. nat.*, 1928, 28, 347–56, 1 pl.). When viewed in the living condition the macronucleus has an external granular layer which by the Feulgen technique is found to be chromatin.

G. M. F.

Kala Azar.—E. HINDLE ("Further Observations on Chinese Kala Azar," *Proc. Roy. Soc. B.*, 1928, 103, 599–619, 2 pls.). *Phlebotomus major* var. *chinensis* is the most favourable species for the development of Leishmania, and in this insect the flagellates become attached to the lining of the mid-gut and grow forward until they reach the anterior part of the gut. Invasion of the pharynx usually takes six days, and under favourable conditions 25 p.c. of the flies show a proboscis infection. In *P. sergenti* only early development of the flagellates occurs, the infection being dependent on the presence of undigested food material in the gut.

" G. M. F.

Diatoms from Fossil Coal.—D. V. ZANON and R. TUFFI ("Le diatomée del carbon fossile," *Mem. d. Pont. Acad. d. Sci. i nuov. Lincei.*, 1928, 11, 235, 1 pl.). A description of certain diatoms found in Newcastle and other English coals. The following species are discussed:—*Cocconensis helvetica* Brun., *Synedra ulna* Ehrb., *S. biceps* Ktz., *Nitzschia perpusilla* Rabenh., *N. valida* Cl. and Grun., *Melosira crenulata* var. *tenuis* Grun., *Tricerathium favus* Ehrb.

G. M. F.

Host-Parasite Specificity in the Coccidia of Mammals.—J. M. ANDREWS (*J. Parasitol.*, 1927, 13, 183–94). Cross-infection experiments were carried on with mature coccidial oocysts from cats, dogs, skunks and opossums. Oocysts from cats and dogs were reciprocally infective, but were the only instances in which coccidia from one mammal infected another. Oocysts from the rabbit placed, by operative procedure, within the intestine of cats and dogs do not excyst as speedily as do the natural coccidia of these hosts. Difference in rate of excystation of natural and foreign coccidia may be a considerable factor in host-parasite specificity. Merozoites from rabbits placed within the intestine or liver of cats and dogs failed to be infective to them, although the merozoites of one cat or dog are infective to another. Digestion probably operates as a factor in host-parasite specificity in two ways—by failing to cause excystation of foreign oocysts and by destroying the foreign merozoites and not the natural ones.

Biological Abstracts.

Blood Protozoa in Formosan Animals.—M. OGAWA and J. UEGAKI ("Beobachtungen über die Blutprotozoen bei Tieren Formosas," *Arch. Protistenk.*, 1927, 57, 14–30, 3 pls., 87 text-figs.). Blood examinations were made of various vertebrates; descriptions, measurements, and drawings of the parasites are given in most cases. Parasites belonging to *Haemoproteus* were found in five species of birds. The mature gametocytes varied in form and in their effects on the parasitised red cells in the different hosts. The authors consider this indicative of specific difference in the parasites. Four birds were found infected with repre-

sentatives of *Proteosoma*. Trophozoites, segmenting schizonts, and mature gametocytes were found in the erythrocytes. Mature gametocytes of *Leucocytozoon* were found in the leucocytes of one bird; only a few trophozoites were found. *Hæmogregarina* was found in three species of snakes. Parasites found in different host species varied. The old stages in the red cells were usually capsulated. Various stages of schizogony were observed in the lungs and liver of *Natrix stolata*. Different kinds of trypanosomes were found in two species of birds. The parasites were more plentiful in the spleen and bone marrow than in the blood. Several species of fish were also found infected. In some host species there were two, three, and four different types of trypanosomes, two types with establishment of infection, and in cats the condition of the stools returns to normal when the infection spontaneously disappears. The conclusion is that under certain circumstances infection with this parasite definitely induces diarrhoea.

Biological Abstracts.

Studies on *Uroleptus mobilis*.—M. L. AUSTIN ("I. An Attempt to Prolong the Life-Cycle. II. The Conditions Necessary for Conjugation," *J. Exp. Zool.*, 1927, **49**, 149-216.) I. In all the experiments to prolong the life-cycle the type and slope of the life-cycle curve were frequently changed by either accelerating or retarding the division rate, but no very remarkable prolongation of life was obtained. In an experiment to test the normal variations in the life-cycles of four series—all started from a single individual and given the same treatment during life—the results showed that lines within a race may respond differently to a stimulus, may vary in tendency to conjugate, may show wide variations in the total number of generations and days attained during life. II. A series of experiments on the factors favouring conjugation seemed to demonstrate: (1) that ability to conjugate is determined, first of all, by internal factors characteristic of a race or of lines within a race; and (2) that, given the ability to conjugate, a culture is stimulated to conjugate by certain external conditions, an important one of which seems to be the accumulation of CO₂ (with its attendant lowering of pH), provided the O content and the food supply are sufficient to maintain the health of the culture.

Biological Abstracts.

The Formation of Contractile Vacuoles in *Amœba proteus*.—H. C. DAY (*J. Morph. and Physiol.*, 1927, **44**, 363-72, 6 text-figs.). The history of investigations on the contractile vacuole is reviewed briefly and brought up to date. The contractile vacuole in *A. proteus* is studied from standpoints of origin, structure, behaviour, and function in normal organisms and from their reactions in conductivity water. Dark-field illumination studies showed that the vacuole is formed from a fusion and coalescence of extremely minute droplets. The retaining "wall" of the contractile vacuole is not a permanent structure, but is in the nature of a condensation membrane, totally disappearing with each contraction. The loci of the contractile vacuoles are not permanent; vacuoles are formed more or less at random. It is unlikely that they are supported in gelled areas, for amœbæ with a dozen vacuoles are quite active, and there is no interference with amœboid movement. Conductivity water increases the size, number, and rate of contraction of contractile vacuoles, which suggests that they may function in maintaining an osmotic gradient as well as in the elimination of metabolic waste.

Biological Abstracts.

Behaviour of *Paramecia* in Pure Lines toward Cell Poisons.—F. M. LEHMANN ("Über das Verhalten von Paramæcien in reinen Linien gegenüber Zellgiften," *Sitzungsber. Ges. Naturf. Freunde, Berlin*, 1927, **1925**, 23-4). A

pure-line isolation culture of *P. caudatum* which showed many abnormalities in form and division rate was subjected to certain physical stimuli (heat) and chemical agents (carbolic acid). The same stimulus produced very different effects on the division rate of individuals in the culture. This difference was taken as indicating the existence of variations among individuals in their power of "regeneration" in the general sense. It is believed that under pathological conditions the behaviour of each individual *Paramecium* is more easily established than under normal conditions, since normally the variations of division rate do not occur so strikingly.

Biological Abstracts.

Some Behaviours of *Vampyrella lateritia* and the Response of *Spirogyra* to its Attack.—F. E. LLOYD (*Papers Michigan Acad. Sci.*, 1927, 7, 395–416, 3 pls., 2 text-figs.). The *Vampyrella* observed fed exclusively on *Spirogyra weberi* and *S. longata*. After coming to rest upon a cell, it spreads out on it more or less. By hydrolysis a definite oval portion of the cell wall bulges into the animal until it bursts, due to the turgor pressure of the attacked cell. The inrush of water causes sudden expansion of the animal, in which a vacuole is thus set up—the receptive vacuole. The lining of the vacuole is probably ectoplasmic. It is folded into meridional ridges forming interior buttresses. A mechanical condition is thus supplied by which suction may be applied. Usually the whole of the living contents of a *Spirogyra* cell are ingested. That the whole of the sap is taken in is doubtful. After ingestion is complete, the mouth closes over the mass. In the meantime more or less of the *Spirogyra* protoplasm and chloroplast is engulfed in the cytoplasm and there rests in fragments in food vacuoles. The receptive vacuole gradually disappears. During and after feeding there is great contractile vacuolar activity whereby water is excreted. The contractile vacuoles are numerous and minute. During feeding there usually occur active contractions of the body accompanied by the simultaneous ejection of minute granules regarded by the author as fecal matter. During feeding also the pseudopodial activity subsides, resulting in disappearance of all but those pseudopodia used for anchoring. The whole operation of attack and feeding occurs in approximately 20 minutes. In hydrolysis of the wall of an attacked *Spirogyra* cell, since there are two chemically different membranes to be hydrolysed, two kinds of enzymes may be inferred to be secreted by the animal. When hydrolysis ends in bursting, the cells suffer a mechanical abjection if the contingent cell or cells are normal. During this period and before abjection, the chloroplast begins to swell, first in the region near the point of attack and then throughout its length until it finally beads off, assuming forms of minimal area of surface. In the swollen condition the chloroplast is hollow and its interior is traversed by ridges and trabeculae. The withdrawal of the chloroplast is much more rapid than that of the cytoplasm. This and its manner of separating from the end-walls indicate that the cytoplasm is not a sac lying against the cell-wall, but is intimately related to it. During the resting period the chlorophyll masses retain a green colour until they disappear. Concurrently an orange-red pigment accumulates in vesicles in the cytoplasm of the animal. To judge from observation, there may be two resting forms, one a digesting condition with high vitality, the other a strictly resting condition of low vitality. The hyaline border, a zone including the ectoplasm but more extensive than it, evident in the early portion of the resting condition, gradually disappears. Meanwhile contractile vacuoles are active. The resting animal is invested by two cellulose membranes. It exhibits some degree of polarity. The active animal exhibits functional polarity (a) in the disposition of pseudopodia in movement; (b) in the constancy of position of its axes; (c) in the (probable) constancy of the place at

which the excretion of a cellulose-dissolving (and other ?) enzyme and at which also the mouth appears.

Biological Abstracts.

Certain Structures of Some Ciliated Protozoa in Relation to Contractility.—A. PENSA ("Particolarità strutturali di alcuni protozoi cigliati in rapporto con la contrattilità," *Monitore Zool. ital.*, 1926, 37, 165-73, 1 pl.). The movements of *Balantidium duodeni*, parasitic in frogs, are due to contractility of the protoplasm. The author finds a complex fibrillar structure present which is disposed in two systems: an axial system with fibres radiating from a central region toward the periphery, which subdivide and terminate in the ectoplasm; an axial system consisting of a group of fibres extending from the posterior pole forward to terminate in the ectoplasm of the mouth and lips. These systems are not believed to be similar to the "neurophanes" of Nieresheimer nor that they are myonemes, "but rather like the neuromotor apparatus of the University of California school of zoologists, at least morphologically." The author does not believe that these fibres exist permanently with the definiteness revealed by the technical methods employed, but rather that they consist of colloidal particles with particular orientations connected with contractility, which become "morphological" structures only after fixing and staining.

Biological Abstracts.

A Neuromotor Apparatus in the Ciliate *Dileptus gigas*.—J. P. VISSCHER (*J. Morph. and Physiol.*, 1927, 44, 373-81). A system of fibres has been found which is probably a neuromotor apparatus. A distinct elongated basal rod, found near the base of the gullet, give rise to three sets of fibres: (1) a set of heavy fibres radiates out around the funnel-shaped gullet; (2) a pair of heavy fibres passed directly from the basal rod to the band of trichocysts, one on each side, extending to the tip of the proboscis; (3) a set of very delicate branching fibres is distributed over the surface of the organism. This system of fibres is held to be a neuromotor apparatus, because (1) the general structure and appearance of the fibres suggest a neuromotor function; (2) there is little or no evidence indicating any other function; (3) the fibres in this system are connected to the most highly specialised structures in *Dileptus*; (4) they are similar to structures found in other forms for which a neuromotor function has been experimentally demonstrated.

Biological Abstracts.

The Periods of Foraminiferal Research.—J. J. GALLOWAY ("The Change in Ideas About Foraminifera," *Jour. Palæont.*, 1928, 3, 216-28). A presidential address in which the author traces the change in ideas which has taken place between the time when foraminifera were first noticed in literature to the present time. Eight fairly well-defined periods are recognised, each characterised by a particular viewpoint regarding the nature and relationships of the organism. The first period is described as 500 B.C.-A.D. 1550, when foraminifera were regarded merely as curiosities by the few observers who noticed them. Subsequent periods mark the times when they were recognised as organisms, as cephalopods, d'Orbigny's classification, recognised as protozoa, the rise of the English school 1858-1884, the biologic period 1884-1917. We are now entering upon the eighth period instituted by the application of micro-palæontology to the solution of stratigraphic and structural problems in geology—in other words, the relation of foraminifera to "oil" deposits. The abstractor suggests that a ninth period will shortly commence, to be devoted to clearing up the mess occasioned by the spate of American publications and the changes resulting from an unfortunate application of the rules of priority in nomenclature.

A. E.

Tertiary Foraminifera from Ecuador.—J. J. GALLOWAY and M. MORREY ("A Lower Tertiary Foraminiferal Fauna from Manta, Ecuador," *Bull. Amer. Palæont.*, 1929, **55**, 7-56, 6 pls.). The smaller fossil foraminifera from South America have hitherto been almost entirely unknown. Bornemann described one species from the tertiary of Rio de Janeiro so far back as 1855, after which there is a gap until 1928, when Berry listed 25 species from Peru. Now, in connection with the search for oil, a foraminiferal fauna of great interest has been discovered in Ecuador; 88 species and varieties belonging to 39 genera are described and admirably figured, of which 10 species and one variety are described as new. The authors comment on the relatively few new species in view of the previously unknown character of the South American deposits. The age of the fauna is unknown except on such evidence as the foraminifera furnish. The type species with which the Ecuador specimens have been identified range from Eocene to recent, but, on the basis of specialised forms and the general resemblance of the fauna to that of other established horizons, the age of the deposit is judged to be Upper Eocene.

A. E.

Palæozoic Foraminifera.—J. A. CUSHMAN and J. A. WATERS ("Upper Palæozoic Foraminifera from Sutton County, Texas," *Jour. Palæont.*, 1928, **4**, 358-71, 3 pls.). The material studied came from a well-section and is of Upper Pennsylvanian and Lower Permian age. A number of new species are described, also a new genus, *Spandelina*, which includes forms externally very similar to some of the genera of the Lagenidæ, but derived directly from such ancestral genera as *Geinitzina* and *Monogenerina*, the early stages of the microspheric forms demonstrating this relationship. The aperture is round and terminal, but not radiate as in the Lagenidæ. *Spandelina*, therefore, presents examples of parallelism such as are found in other groups. The series shows the development of perforate calcareous forms from agglutinated ones.

A. E.

Foraminifera from Paris Basin.—J. A. CUSHMAN ("Foraminifères du Stampien du Bassin de Paris," *Bull. Soc. Sciences de Seine et Oise*, 1928, **9**, 47-63, 3 pls.). The material from these strata has not previously been examined. The beds are sandy, and foraminifera are not common, but by floating and concentration sufficient material was obtained to yield over 20 species, including several new species or varieties. On the whole, the fauna resembles the Miocene of the Vienna Basin and Bavaria, but some species are typical of the Oligocene of Alsace and the Mayence Basin.

A. E.

Astrorhizidæ in Shallow Water.—E. LACROIX ("De la présence d'une faune d'astrorhizidés tubulaires dans des fonds littoraux de Saint-Raphaël à Monaco," *Bull. de l'Institut Oceanographique*, 1928, **527**, 1-16, 16 text-figs.). The Astrorhizidæ as a group are characteristic of the cold waters of the deep sea and of high latitudes. It is therefore remarkable that they should be found to exist in considerable numbers and variety in the Coralline zone of the Monaco region at depths between 30 and 70 metres, where the bottom temperature ranges between 12° and 20° C., and living in association with all the commoner species of foraminifera normally found in such a locality. In this preliminary note 13 species are described and figured, including a new species of *Rhabdammina* (*R. pseudolinearis*) and two new species of *Hyperammina* (*H. flexuosa*, *H. dubia*). The author intends to continue the research with the object of solving the biological problems raised by the discoveries.

A. E.

Tertiary Foraminifera from Trinidad.—W. L. F. NUTTALL ("Tertiary Foraminifera from the Naparima Region of Trinidad (British West Indies)," *Quart. Jour. Geol. Soc.*, 1928, 1, 57–115, 6 pls., 2 tables, 13 text-figs.). One hundred and forty-four species and varieties are identified, and it is stated that the list is not exhaustive. The material was collected from test-pits, 1½-inch auger-holes, and wells drilled with either rotary or cable tools, precautions being taken to prevent the mixing of the samples, which numbered 1,270, averaging 2 lbs. in weight. After washing, the material was hand-picked for foraminifera by natives, who are stated to have worked without a lens and to have become so expert that, when their results were checked with a lens, it was found that only some of the smallest species were being missed. The two tables show the stratigraphical distribution of the commoner and rarer species, in order of abundance, which ranges from 99 to 4 p.c. To obtain these percentages, in each sample examined the occurrence of a certain species, apart from its abundance or rarity, was noted. It is claimed that about 25 of the species are of the greatest stratigraphical value. The fauna in general indicate warm water at a depth of about 400 fathoms. The paper is well illustrated. A. E.

Indian Tertiary Foraminifera.—L. M. DAVIES ("The Ranikot Beds at Thal (North West Frontier Provinces of India)," *Quart. Jour. Geol. Soc.*, 1927, 2, 260–90, 1 diagram, 6 text-figs.). Fifteen species and varieties of foraminifera were collected from beds of the Upper and Lower Ranikot series on the Tirah frontier of India, of which nine belonging to the genera *Nummulites*, *Operculina*, *Siderolites*, *Dictyoconoides* and *Discocyclina*, are described as new. The beds are of Lower Eocene age, and are believed to correlate with the Moutran and middle Landenian of Europe. A. E.

Lepidocyclina in Eastern Deposits.—I. M. VAN DER VLIERK ("The genus *Lepidocyclina* in the Far East," *Compt. rend. Soc. paléont. suisse*, 1928, 1, 182–211, 18 pls., 3 tables, 1 diagram in text. This paper has also been published in Dutch ("Het Genus *Lepidocyclina* in het Indo-pacifische gebied," *Wetenschappelijke mededeelingen* no. 8). This paper, which is in English, is already in such a compressed and tabular form as to defy abstracting. It should prove of the greatest value to all students of Orbitoid foraminifera, as it contains an analysis, revision, and classification of all records, with detailed data of all accepted and rejected species, of the megalospheric and microspheric forms, and of their geographical and stratigraphical distribution. There is a bibliographical list of no less than 127 papers dealing with the subject, and the paper is admirably illustrated by reproductions of photographs of specimens and sections. A. E.

The Ecologic Factor in Micropalæontology.—H. G. SCHENK ("The Biostratigraphic Aspect of Micropalæontology," *Jour. Palæont.*, 1928, 158–65, 1 pl.). The determination of ecologic conditions should be considered in correlating formations because dissimilar faunas may be of identical age and *vice versa*. There is a diagrammatic plate illustrating the distribution of *Cassidulina* in the N. Pacific, which supports the author's view that an abundance of that genus in a fossil formation merely indicates cool water and not necessarily a Pliocene origin, as has been postulated by another writer. A. E.

Mexican Foraminifera.—W. STORRS COLE ("A Foraminiferal Fauna from the Chapapote Formation in Mexico," *Bull. Amer. Palæont.*, 1928, 53, 203–32, 3 pls.). The Chapapote formation consists of grey indurated clays which are very rich in certain pelagic types of foraminifera, and the abundance of *Hautkenina alabamensis*,

together with certain other forms, suggests a correlation with the Upper Eocene (Jackson) of the Gulf States. But so far no mollusca or other fossils have been found to check this correlation. The foraminifera represent a moderately deep-water fauna. The paper is well illustrated. By the same author, and associated with the foregoing paper, but without indication on the title-page, are a note on "A New *Lepidocyclina* from the Upper Oligocene in Mexico" (*op. cit.*, 221-2, 1 pl.) and a very useful list of 18 papers by various authors who have specifically described Mexican foraminifera (*op. cit.*, 223).

A. E.

A New Orbitoid.—J. J. GALLOWAY ("Notes on the genus *Polylepidina* and a New Species," *Jour. Palæont.*, 1928, 4, 299-304, 1 pl., 3 text-figs.). *Polylepidian* was created by Vaughan (1924) as a sub-genus of *Lepidocyclina*, but no categorical definition was published. As the form possesses special interest owing to its primitive structure and its occurrence in cretaceous strata, it is proposed to raise *Polylepidina* to generic rank under an enlarged definition which will include recent discoveries.

A. E.

The Orbitoid Foraminifera.—J. J. GALLOWAY ("A Revision of the Family Orbitoididae," *Jour. Palæont.*, 1928, 1, 45-69, 4 text-figs.). The Orbitoididae are the largest, most complex and highly evolved of the foraminifera, and, like all giant races, have been short-lived in geologic time, and are therefore among the most reliable index fossils. They appear first in the Upper Cretaceous, are common in the Eocene, reach their maximum point in the Oligocene, become rarer in the Miocene, and very rare in the Pliocene. To-day they are represented by a single genus only, *Cyclocypeus*, and are confined to tropic waters. The family includes those discoidal foraminifera which are composed of a median zone of chambers and two lateral zones of chambers or laminæ, and the genera are divided into three well-marked groups: (1) with lateral laminæ and rectangular median chambers, the sub-family Cyclocypeinæ; (2) with lateral chambers and rectangular median chambers, the sub-family Discocyclininæ; and (3) with lateral chambers and non-rectangular median chambers, the sub-family Orbitoidinæ. Of the 42 generic names which have been proposed, 24 are accepted as valid and distinct, the others become synonyms under the rules of nomenclature. Only one important change in nomenclature is, however, made, viz., the substitution of *Cyclosiphon* Ehrenberg (1855) for *Lepidocyclina* Gümbel (1870). In view of the enormous literature connected with Gümbel's name, the inevitable change is most unfortunate.

A. E.

Palæozoic Foraminifera from Oklahoma.—J. J. GALLOWAY and B. H. HARTON ("Some Pennsylvanian Foraminifera of Oklahoma, with Special Reference to the genus *Orobias*," *Jour. Palæont.*, 1928, 4, 338-57, 2 pls.). Palæozoic foraminifera are naturally less well-preserved than more recent ones, and the difficulty of determining the wall material and texture, added to the fact that some authors have paid no attention to these factors, has led to much confusion. The authors hold that the tests of nearly all Palæozoic forms are calcareous and secreted, not agglutinate as commonly held, and that all the *Arenarca* have been derived from calcareous forms. The material described has been studied with particular reference to wall material and texture. Nine new species are described, also a new genus, *Tuberitina*. *Orobias* Eichwald (1860) is revived in place of later synonyms, and 19 species belonging to that genus are described, of which three are new.

A. E.

Structure and Affinities of *Pellatispira*.—J. H. F. UMBGROVE ("Het genus *Pellatispira* in het Indo-Pacifische Gebied," *Wetenschappelijke Mededeelingen*, 1928, 10, 43–71, 16 pls., 10 diagrams in text). The affinities of *Pellatispira* have long been in doubt. Boussac, who founded the genus in 1906, placed it with the Nummulitidae, but Yabe and others have transferred it to the Rotaliidae. An exhaustive study of material, including sections impregnated with canada balsam and subsequently decalcified, has demonstrated the absence of spiral canals such as might have been expected in a rotaline form, and the presence of a marginal plexus running at the dorsal side of the chambers, a structure typical of the Nummulitidae. Boussac was therefore correct in regarding *Pellatispira* as a nummulite closely allied to *Assilina*. The genus is known so far only from Eocene strata in the Old World. The specimens found by Provalc, Rutten, and Yabe in rocks from North Borneo in association with *Lepidocyclina* and *Spiroclypens* (which are Miocene forms) must be regarded as derived from an Eocene marl which has been washed away and redeposited. Several new species are described; they occur in both the microspheric and megalospheric form, but no evidence of trimorphism in the sense of Hofker has been detected. A. E.

Tertiary Foraminifera from Cyrenaica.—A. SILVESTRI ("Nummuliti, *Operculina* e *Planorbulina* di Derna nella Cirenaica," *Mem. Pont. Accad. delle Scienze—I Nuovi Lincei*, 1928, ser. 2, 11, 263–78, 1 pl., 3 text-figs.). Two species of *Nummulites* and one each of *Operculina* and *Planorbulina* occurring in this formation are discussed, with special reference to synonyms and affinities. The paper is well illustrated by photographs of the specimens and diagrammatic woodcuts. A. E.

Tertiary Foraminifera from Oregon.—J. A. CUSHMAN and H. G. SCHENCK ("Two Foraminiferal Fannules from the Oregon Tertiary," *Univ. of Calif. Publ. Bull. Dept. Geol. Sci.*, 1928, 9, 305–24, 4 pls.). Describes the foraminifera from the Bassendorf and Keasey shales of the Oregon coast range, and from their evidence concludes that the two deposits are of the same age, which is probably lowest Oligocene, although there are some species which range into the uppermost Eocene. Several new species are described, and the paper is well illustrated. A. E.

The Ehrenberg Collections.—J. A. CUSHMAN ("Notes on Foraminifera in the Collections of Ehrenberg," *Jour. Washington Acad. Sci.*, 1927, 19, 487–91.) Between 1838 and 1872 Ehrenberg described and figured an enormous number of organisms of all kinds, the status of many being still uncertain. Cushman has been studying his collections, which are preserved at the University of Berlin, in an attempt to determine the genotypes of his foraminifera. The preparations are chiefly balsam mounts, but for the most part in excellent condition, slightly yellowed with age, but very clear and showing no signs of deterioration. The collection is contained in a number of book-like holders with volume numbers and general localities marked on the backs. In each volume are usually twelve double cardboard trays, hinged at the back, and numbered and named on the top. These trays, when lifted out and carefully opened, display the mounts themselves, made of small cover-glasses with balsam between and fastened to strips of mica, five mounts to each strip. The ends of the strip are inserted in slits in a large sheet which fits into the tray, and often bears on the lower part a list of the included species. On the surface of the cover-glasses are very small rings of various colours, each ring containing figured or named specimens. There is a catalogue, arranged by Ehrenberg, giving the genera, and under each genus the species and the details

of the book and tray in which it is to be found. There is also a collection of more than 2,500 sheets of Ehrenberg's original drawings in pencil, ink, and water-colours. Many of the sheets contain numerous figures. They are accurately drawn and much superior to his published plates. Each individual figure bears a notation in ink or pencil referring to the volume, tray, strip, slide and coloured ring, so that the original specimen can be quickly found. The system is complex, but very workable, as the catalogue gives under each species a reference to the sheet of drawings on which it is figured. The paper contains notes on certain species of Ehrenberg's which are regarded as of special interest in settling questions of American nomenclature.

A. E.

The Oral Aperture and its Development.—J. A. CUSHMAN and J. A. WATERS ("The Development of *Climacammina* and its Allies in the Pennsylvanian of Texas," *Jour. Palæont.*, 1928, 2, 119–30, 4 pls.). There are two distinct genera of arenaceous foraminifera in this formation which are biserial in the early stages and subsequently uniserial. Some of these have been referred erroneously to *Cribrostomum* Möller, but in that genus there are many rounded apertures which appear even in the early biserial stages. Such a condition does not apparently occur in the Texas material. One genus with multiple apertures appearing in the adult in regular sequence seems referable to *Climacammina* Brady. The other having two elliptical apertures is apparently new, and the name *Deckerella* is instituted for it. Both genera are represented by two or more species with definite stratigraphic ranges.

A. E.

Early Figures of American Foraminifera.—J. A. CUSHMAN ("The American Cretaceous Foraminifera Figured by Ehrenberg," *Jour. Palæont.*, 1927, 3, 213–17, 3 pls.). Plate 32 of Ehrenberg's *Mikrogeologie* (1854) consists entirely of American cretaceous foraminifera. The plate is divided into two parts, the first illustrating specimens from "Schreib-Kreide des Missouri-Gebietes," the second from "Schreib-Kreide des Mississippi-Gebietes," no closer localities being furnished. Many of the species had been described by Ehrenberg in earlier years, but not figured. As so much work is being done in America on their cretaceous beds, the figures are reproduced for the benefit of workers with Ehrenberg's identifications and brief notes on certain genotypes based on a study of the original specimens which are preserved in Berlin.

A. E.

BOTANY.

(Under the direction of A. B. RENDLE, D.Sc., F.R.S.)

GENERAL.

Cytology.

Smear Preparations.—JOHN BELLING ("A Method for the Study of Chromosomes in Pollen Mother-Cells," *Univ. Calif. Publ. Bot.*, 1928, **14**, 293-9). Full details are given of a new method for fixing and staining smear preparations. Fixation by a chromic-acetic-formaldehyde mixture is followed by staining with brazilin after mordanting with iron alum. The method eliminates the use of expensive osmic acid, allows all the processes to be carried out in 70 p.c. alcohol, thus avoiding long soaking in watery media, and gives excellent results of the early thread stages in smeared pollen mother-cells. J. L.

Chromomeres of *Lilium*.—JOHN BELLING ("The Ultimate Chromomeres of *Lilium* and *Aloë* with Regard to the Numbers of Genes," *Univ. Calif. Publ. Bot.*, 1928, **14**, 307-18). Pollen mother-cells of *Lilium* and *Aloë* have been studied in smear preparations fixed with chromic-acetic-formaldehyde and stained with iron-brazilin. The pachyphase threads (homologous threads completely joined together) appear brown or colourless, while the chromomeres stain black. Reasons are given for considering uniform or coarsely segmented pachyphase threads to be the results of post or inter-mortem change. The ultimate chromomeres in *Lilium* at this stage are bivalents, and each homologous half is divided into two spherules. These spherules are called chromioles. The ultimate pachyphase chromomere, therefore, consists of two pairs of sister chromioles. Occasionally one pair of sister chromioles is smaller than its homologous pair. The chromomeres show great variation in size. It has been calculated that about 2,000 bivalent chromomeres are contained in the pachyphase thread of *Lilium pardalinum*. In *Aloë striata* the coiled pachyphase threads are shorter and the chromomeres smaller and closer. About 1,400 are calculated to be present on the threads, but reasons are given for considering this number too small. The writer points out the parallelism between chromomeres and genes, and considers that the assumption that chromomeres are genes is necessary as a working hypothesis. J. L.

Segmental Interchange between Chromosomes.—JOHN BELLING ("A Working Hypothesis for Segmental Interchange between Homologous Chromosomes in Flowering Plants," *Univ. Calif. Publ. Bot.*, 1928, **14**, 283-91). A working hypothesis which fits the facts already known is put forward. It includes the following assumptions: (1) That breaks in the chain of genes (not in the chromosome thread) occur at leptophase (thin thread stage) with the homologues already split. (2) That these breaks are at random in each of the two sister strands, except for there being a certain minimum and maximum limit between consecutive breaks. (3) That when two breaks in different strands happen to coincide at pachyphase

(widened thread stage), i.e. when the breaks are between the same two adjacent genes or allelomorphs, the two broken left-hand ends unite at random with the two broken right-hand ends as the bivalent shortens. The result is that either the original ends reunite, or a cross (chiasma, or point of segmental interchange or of crossing over) is formed. J. L.

Chromosomes of *Vicia*.—IRENE SWESCHNIKOWA ("Die Genese des Kerns im Genus *Vicia*," *Verhandlungen V Internationalen Kongresses Vererbungswissenschaft, Berlin*, 1927. *Sup. II Zeitschrift induktive Abstammungs- und Vererbungslehre* 1928, 1415–21). The chromosomal complexes of three races of *Vicia cracca* with diploid chromosome numbers 12, 14 and 28 are described. Both 12- and 14-chromosome forms have two pairs of chromosomes with arms, two pairs with small heads, and one pair with a round satellite. In addition, the 12-chromosome form has one pair with two long arms, while the 14-chromosome form has one pair with a head and one pair with a very short arm. These differences are accompanied by external differences of stem, leaf, flower, time of flowering and general vitality, the 14-chromosome form showing superiority. The 28-chromosome race is the tetraploid of the 14-chromosome form and has a much larger nucleus. The chromosome types are the same, but only one satellited pair is present. The habit of the two forms is similar except for larger leaflets and greater fruiting power of the tetraploid. The group *V. sativa* also shows parallel differences of chromosomes and external features. Normal *V. sativa* ($2n = 12$) and *V. angustifolia* ($2n = 12$, possibly a variety of *sativa*) have three pairs of chromosomes with small heads, one pair of three-limbed chromosomes, one pair of dwarf chromosomes, and one large two-armed chromosome A. The larger arm of A is much longer in *angustifolia*. External differences are present, chiefly in the characters of the seeds. The chromosomal complexes show variation within *V. angustifolia*. Both arms of chromosome A may be extremely elongated, and the dwarf chromosome enlarged. In these cases there is also increase in plant size, number and size of flowers, and general fertility. Another race of *V. sativa* has only 10 diploid chromosomes: three pairs with small heads, one pair of three-limbed chromosomes, one pair of A chromosomes with one arm very shortened, and no dwarf pair. This reduction in chromatin is accompanied by reduced numbers of leaves, flowers and fruit, and feeble growth. J. L.

Chromosomes of *Trifolium*.—HAAKON WEXELSEN ("Chromosome Numbers and Morphology in *Trifolium*," *Univ. Calif. Publ. Ag. Sci.*, 1928, 2, 355–76). The diploid chromosome numbers are given for the following American species of *Trifolium*:—*T. obtusiflorum* 16, *T. obtusiflorum* var. *majus* 16, *T. variegatum* 16, *T. Wormskjoldii* 48?, *T. microcephalum* 16, *T. fucatum* 16, *T. fucatum* var. *virescens* 16, *T. alboburpureum* 16, *T. dichotomum* 32, *T. reflexum* 16, *T. ciliolatum* 16. Other species counted are:—*T. pratense* 14, *T. incarnatum* 14, *T. repens* 32, *T. hybridum* 16, *T. glomeratum* 16, *T. minus*? 32, *T. subterraneum* 16, *T. Alexandrinum* 16. The following series of haploid chromosome numbers is now established in 43 species of *Trifolium*—7, 8, 14, 16, 24, 48? 130? The basic numbers are 7 and 8. Amongst species studied from America there is no representative of the 7 series which is found among the European species. The chromosomes of *Trifolium* are of small size, but exhibit great variation both in size of individuals and in total amount of chromatin of the chromosome complexes. There is no great variation in any one haploid set. The above species can be arranged in three groups according to the chromosome size being large, medium or small, but this grouping is not considered of phylogenetic significance. Variation in chromosome size is known to occur in the species *T. repens* between the varieties *giganteum* and

sylvestre. *Giganteum*, a giant variety, has large chromosomes, and *sylvestre*, a small variety, has considerably smaller chromosomes. The F_1 plants from these two varieties show chromosomes of intermediate size. Ten species, representing six sections of the genus, have one pair of satellited chromosomes. In *T. minus* there are probably three such pairs. The satellites sometimes appear to lie free on the mitotic metaphase plates, resembling an extra pair of small chromosomes. A few diakinesis plates of *T. pratense* show two bodies which are interpreted as a pair of satellites attached to a bivalent chromosome. Constricted chromosomes appear in several species, the constriction being sub-terminal. A scheme of chromosome morphology is given for four of the species on the basis of constrictions, satellites, and chromosome size. Nine species were crossed in various different combinations, but completely negative results were obtained. In *Trifolium* there is no parallelism between differentiation of the chromosome complexes and the external morphology of the species. The evolution of the chromosome complexes is discussed, and the suggestion made that the diversity of such complexes in *Trifolium* is a result of mutational changes in species which have become isolated by intersterility rather than the result of hybridisation.

J. L.

Haploids in *Crepis*.—L. HOLLINGSHEAD ("A Preliminary Note on the Occurrence of Haploids in *Crepis*," *Am. Nat.*, 1928, **62**, 2-4). The haploid chromosome number in *Crepis* is three. In 1,700 F_1 hybrids of *Crepis capillaris* \times *C. tectorum* two haploid *C. capillaris* plants have been found. Their occurrence may be due to the low temperature at the time the crosses were made, or to the development of an unfertilised egg stimulated by the growth of the *tectorum* pollen on the stigma. Still in the rosette stage the plants are smaller than the normal diploid. The cells of the root-tips are also smaller and the chromosomes of the haploid set appear somewhat reduced in size. Diploid tissue is present in the roots of one of the haploid plants. This has presumably resulted from doubling of the haploid complex.

J. L.

Supernumerary Chromosomes.—A. E. LONGLEY ("Supernumerary Chromosomes in *Zea Mays*," *Jour. Agric. Research*, 1927, **35**, 769-84). The haploid chromosome number for most maize varieties is 10. These 10 normal chromosomes show morphological differences which have been studied in the heterotypic division of the microspore mother-cells. At metaphase the chromosome set consists of six double Vs with central fibre attachment, two double Vs with subterminal fibre attachment, a large figure 8 and a very small chromosome, both with terminal points of attachment. These 10 bivalent chromosomes behave regularly throughout meiosis. Certain maize varieties have a somatic chromosome number greater than 20. The supernumerary chromosomes are small, with terminal spindle fibre attachment, resembling the tenth chromosome of the normal set. The behaviour of one such supernumerary chromosome has been studied in meiosis and is found to be erratic. This extra chromosome does not divide at the heterotypic division, and undergoes non-disjunction in varying percentages on the homotypic spindle. Thus spores with 10, 11 or 12 chromosomes are produced. Five progenies of a 20-chromosome ♀ \times 21-chromosome ♂ have been studied, and show that non-disjunction varies from 0-100 p.c. in microspore mother-cells. Four progenies of a 21-chromosome ♀ \times 20-chromosome ♂ show that non-disjunction is approximately 26 p.c. and therefore more stable in megaspore mother-cells. A differential death-rate appears to eliminate some of the megaspore mother-cells with two extra chromosomes, though the additional numbers in no way affect pollen viability.

J. L.

Polyploidy and Sterility in *Rubus* and *Fragaria*.—A. E. LONGLEY ("Relationship of Polyploidy to Pollen Sterility in the Genera *Rubus* and *Fragaria*," *Mem. Hort. Soc., New York*, 1927, 3, 15–17). The basic chromosome number in *Rubus* is seven. Forms with even chromosome numbers, that is, diploids, tetraploids, hexaploids and octoploids, have a large percentage of good pollen. These forms have probably originated from the union of sex cells of similar character and having the same number of chromosomes. Triploid and pentaploid forms produce a very small percentage of good pollen. Such forms probably originated by the union of distantly related sex cells having different chromosome numbers. The dioecious *Rubus Chamæmorus* is octoploid ($n = 28$). In the genus *Fragaria* all diploid forms are hermaphroditic, and the dioecious condition is found only amongst the polyploids. If dioeciousness is a degeneration and sterilisation of male or female organs of a hermaphroditic form, polyploid forms may have arisen from diploid and consequently be of recent origin. J. L.

Chromosome Numbers in *Ægilops*.—O. N. SOROKINA ("On the Chromosomes of *Ægilops* Species," *Bull. Applied Botany, Genetics and Plant Breeding*, 1928, 19, 523–32. Russian with English summary). Root-tips of 15 species of 8 different sections of the genus were cytologically examined. The following haploid chromosome numbers are given for species and sub-species: *Ae. ovata* (3 sub-species) 14, *Ae. triaristata* (2 sub-species) 14, *Ae. biuncialis* 14, *Ae. triuncialis* (4 sub-species) 14, *Ae. cylindrica* sub-sp. *aristulata* 14, *Ae. squarrosa* (2 sub-species) 7, *Ae. caudata* sub-sp. *dichasians* 7, *Ae. comosa* 7, *Ae. ventricosa* sub-sp. *comosa* 14, *Ae. speltoides* (2 sub-species) 7, *Ae. Aucheri* sub-sp. *virgata* 7, *Ae. bicornis* 7, *Ae. longissima* 7, *Ae. crassa* (2 sub-species) 21, *Ae. turcomanica* 21. $n = 14$ has also been determined for *Ae. variabilis*. Within the limits of a section there are no differences in chromosome number. The systematic groups do not coincide with the chromosome numbers as in *Triticum*. The chromosomes vary in size and shape, and in some species "satellites" are observed. J. L.

Chromosomes in *Ægilops*.—E. SCHIEMANN ("Chromosomenzahlen in der Gattung *Ægilops* I," *Bericht. Deutschen Bot. Gesellschaft*, 1928, 46, 324–8). The following chromosome numbers are given for species of *Ægilops*: *Ae. uniaristata*, *Ae. comosa* var. *subventricosa*, *Ae. caudata* var. *polyathera* of the section *Macrothera*, $2n = 14$. *Ae. speltoides* var. *typica* and var. *ligustica* of section *Platystachys*, $n = 7$. *Ae. ventricosa* of the same section, $n = 14$. *Ae. cylindrica* of section *Monoleptathera*, $2n = 28$. In the section *Pleionathera*, *Ae. triuncialis* $n = 14$, *Ae. ovata* var. *typica* $n = 14$, *Ae. ovata* var. *anatolica* $n = 7$. J. L.

Triticum Hybrids.—I. NISHIYAMA ("On Hybrids Between *Triticum Spelta* and Two Dwarf Wheat Plants with 40 Somatic Chromosomes," *Bot. Mag., Tokyo*, 1928, 42, 154–77. Japanese with English summary). Hybrids between *Triticum Spelta* ($2n = 42$) and two dwarf wheat plants ($2n = 40$) have been investigated. These hybrids are 41-chromosome plants ($20_{II} + 1_I$) of constitution ($D_{-2g} \times T. Spelta$) F_1 , and ($D_{-2f} \times T. Spelta$) F_1 , and reciprocal crosses, where 2_g and 2_f indicate pairs of *g* and *f* chromosomes respectively. The hybrids form 20- and 21-chromosome megaspores in the ratio 73 : 27. The chance of a one univalent chromosome loss in the meiosis of embryo-sac mother-cells is 46 p.c. in ($D_{-2g} \times T. Spelta$) F_1 , and 42 p.c. in ($D_{-2f} \times T. Spelta$) F_1 . Loss of chromosomes occurs with a similar frequency in microspore formation. Among the progenies of $D_{-2g} \times (D_{-2g} \times T. Spelta)$ F_1 and $T. Spelta \times (D_{-2g} \times T. Spelta)$ F_1 , only 11 p.c. were fertilised by 20-chromosome microspores, and among $D_{-2f} \times (D_{-2f} \times T. Spelta)$ F_1 and $T. Spelta \times (D_{-2f} \times T. Spelta)$ F_1 , 37 p.c. This discrepancy

is probably accounted for by lower growth-rate of the pollen-tubes from 20-chromosome microspores. The expected percentages of 40-, 41-, and 42-chromosome progenies of a self-fertilised 41-chromosome plant agree roughly with those observed. The F_2 progenies show various chromosome combinations ranging from $18_{II} + 3_I$ to $20_{II} + 1_I$. The results support the hypothesis of zygotic sterility in wheats. J. L.

Chromosomes of Scirpus.—G. CLAUDE HICKS ("Chromosome Studies in the Cyperaceæ, with Special Reference to Scirpus," *Bot. Gaz.*, 1928, **86**, 295–317). The haploid chromosome numbers are given for the following American species of *Scirpus*:—*S. heterochaetus* $n = 18$, *S. acutus* var. *condensatus* $n = 20$, *S. validus* $n = 21$, *S. atrovirens* $n = 25-30$, *S. georgianus* $n = 28$, *S. rubrotinctus* $n = 33$, *S. Longii* $n = 34$, *S. atrocinctus* $n = 34$, *S. cyperinus* $n = 33$, *S. americanus* $n = 38$, *S. Olneyi* $n = 39$, *S. americanus* (an irregular form and possibly a hybrid of *americanus* and *Olneyi*) $n = 50-64$, *S. campestris* var. *Fernaldi* $n = 55$, *S. campestris* var. *paludosus* $n = 55-57$. The species exhibit aneuploidy, i.e. different numbers of chromosomes which do not come under the law of multiples. Dark-staining chromatic material is present in the cytoplasm during meiotic divisions. This condition is similar to that in certain known hybrid plants. The chromosomes usually show no meiotic irregularities, indicating close relationship of the parent forms. Hybridisation is suggested as the probable explanation of the aneuploid condition in *Scirpus*. J. L.

Generative Cell Formation in Scirpus.—K. PIECH ("Über die Entstehung der generativen Zelle bei *Scirpus uniglumis* Link durch 'freie Zellbildung,'" *Planta. Archiv. f. wissenschaft. Bot.*, 1928, **6**, 96–117), and ("Zytologische Studien an der Gattung *Scirpus*," *Bull. Acad. Polon. Sci. et Lett.*, 1928, 1–43). The first paper is an account of generative cell formation in *Scirpus uniglumis* ($n = 16$). The second paper is a somewhat fuller account of the same phenomena in both *S. uniglumis* and *S. paluster* ($n = 8$), and is illustrated by additional plates. The Cyperaceæ differ from other groups of angiosperms in the formation of their pollen grains and generative cells. After the reduction division in the pollen mother-cells, only one of the four tetrad nuclei develops further, while the other three degenerate in the cytoplasm and are separated off by a plasmatic membrane. The division of the primary pollen nucleus, which gives rise to the generative and vegetative nuclei, takes place in the middle of the young pollen cell. During telophase of this division the phragmoplast increases greatly in width, but does not extend to the cell wall. The spindle threads then become loosened from the vegetative nucleus, the inner ones only remaining attached to it. The outer edges of the phragmoplast bend round, thus bringing the outer threads to radiate vertically from the surface of the generative nucleus. The phragmoplastic threads become thicker in the middle, thus making a clearly marked equatorial zone. The phragmoplast grows round until its edges come in contact with the membrane which separates off the three degenerating nuclei, and here its growth stops. If this membrane is too remote, or already disintegrated, a complete spherical "phragmosphere" is formed round the generative nucleus. During growth of the surrounding phragmoplast, two plasmatic membranes (plasmoderms) are laid down across its equatorial zone in a line between the generative and vegetative nuclei. This appearance of the plasmoderms is followed by disappearance of the phragmoplastic threads. Thus a generative cell is cut off in the middle of the cytoplasm of the pollen cell. When the pollen grain is almost full size, there is always a separate spindle-shaped generative cell cut off from the pollen cell cytoplasm by a special plasma membrane. J. L.

Chromosomes in Ficus.—IRA JUDSON CONDIT ("Cytological and Morphological Studies in the Genus *Ficus*," *Univ. Calif. Publ. Bot.*, 1928, 11, 233-44). Diploid chromosome numbers are determined for seven species of *Ficus* representing three distinct sections of the genus. In section *Eusyce* $2n = 26$ for *F. carica*, *F. pseudocarica*, *F. palmata* and *F. erecta*; in section *Urostigma* $2n = 26$ for *F. elastica* and *F. rubiginosa*; in section *Neomorphe* $2n =$ probably 24 for *F. glomerata*. The haploid number 13 is determined for *F. carica* and *F. palmata*. The chromosomes of the first six species listed are similar in morphological characters, the individuals being very minute, rod-shaped, falcate, slightly hooked or doubly curved. The chromosome morphology of *F. glomerata* is quite distinct, the chromosomes being globular or oblong. It is remarked that further studies of species in the same or other sections of the genus *Ficus* may provide cytological data of taxonomic importance. A brief description is given of the distribution, morphological characteristics and relationships of the species studied. J. L.

Chromosomes of Canna.—J. A. HONING ("Canna Crosses II. The Chromosome Numbers of *Canna glauca*, *C. glauca* \times *indica* F_1 , *C. aureo-vittata* and *C. aureo-vittata* *gigas*," *Mededeel. Landbouwhoogeschool Wageningen (Holland)*, 1928, 32, 1-14). The haploid chromosome number of *Canna indica*, *C. glauca* and *C. aureo-vittata* is $n = 9$. The F_1 progeny of *C. glauca* \times *C. indica* show both bivalent and univalent chromosomes at diakinesis and metaphase. No irregular distribution of the 9 chromosomes to each daughter nucleus is observed. A giant form of *C. aureo-vittata* occurred in the F_3 and F_4 generations from the cross *C. aureo-vittata* deep yellow \times pale yellow. Amongst 3,151 plants of these four generations, seven were *C. aureo-vittata* *gigas*. The giant form exhibits a high degree of sterility. In the pollen mother-cells the quantity of chromatin is doubled, the heterotypic metaphase plates showing either 9 tetravalent chromosomes, or 18 bivalents, or varying numbers of tetravalents, bivalents and univalents. The sterility is accounted for by extreme irregularities in the meiotic divisions, accompanied by degeneration of chromosomes and formation of micronuclei.

J. L.

Chromosomes of Dioecious Plants.—Y. SINOTO ("On the Chromosome Number and the Unequal Pair of Chromosomes in some Dioecious Plants," *Proc. Imp. Acad., Tokyo*, 1928, 4, 175-7). Male plants of the following dioecious species have been investigated:—*Morus bombycis* $n = 14$, *Cannabis sativa* $n = 10$, *Daphniphyllum macropodum* $n = 16$, *Trichosanthes japonica* $n = 11$, *Salix leucopithecia*, *S. sachalinensis*, *S. melanostachys*, *S. viminalis* var. *yezensis*, *S. japonica*, all five forms with $n = 19$. In these male plants an unequal pair of chromosomes is visible at the first meiotic division. Other male plants investigated are *Cudrania triloba* $n = 28$, *Datisca cannabina* $n = 11$, *Trachycarpus excelsus* var. *Fortunei* $n = 18$. In these an unequal pair of chromosomes is probably present, but is not so clearly discernible.

J. L.

Chromosomes of Hydrilla.—Y. SINOTO and K. KIYOHARA ("A Preliminary Note on the Chromosomes of *Hydrilla verticillata*," *Boi. Mag., Tokyo*, 1928, 42, 82-5. Japanese with English summary). The diploid chromosome number in *Hydrilla verticillata* Presl is 24. The chromosomes can be divided into two sets, long and shorter ones. In the reduction division of the pollen mother-cells one geminus consists of one long and one short chromosome. It is suggested that this unequal pair of chromosomes consists of the sex chromosomes. In this case *H. verticillata* is of the XY type, and the male heterogametic.

J. L.

Chromosome Number in *Jussieua*.—YOSITO SINOTO ("Pollen Development of *Jussieua repens*," *Proc. Imp. Acad., Tokyo*, 1928, 4, 231). The haploid number of chromosomes of *Jussieua repens* counted in different stages of the first and second meiotic divisions is found always to be eight. This is a new haploid number for *Oenotheraceæ*. J. L.

Chromosomes of *Pharbitis Nil*.—KONO YASUI ("Studies on *Pharbitis Nil* Choisy. II. Chromosome Number," *Bot. Mag., Tokyo*, 1928, 42, 480–5). A table is given of the chief external character of each of the 11 strains of *Pharbitis Nil* submitted to cytological examination. Plants of each strain invariably have the haploid chromosome number 15. The chromosomes of any one haploid set show many differences in size and shape, and no chromosomal set from any one strain is identical with a set from any of the other ten strains examined. The divisions for pollen formation are usually regular, though occasionally one or two dwarf grains are formed in addition to four normal-sized microspores. The meiotic divisions are not described. J. L.

Nuclear Form.—BESSIE GOLDSTEIN ("Nuclear Form as Related to Functional Activities of Normal and Pathological Cells," *Bot. Gaz.*, 1928, 86, 365–83). Various tissues of *Lilium longiflorum* and its variegated form *L. longiflorum foliis albomarginatis* have been studied, and the following types of nuclear form observed: normal, ridged, cleft, crenate, constricted (these are not an indication of amitosis), spinous, bullate, i.e. with blunt projections, horned, furrowed, amoeboid, lobulate, lobed, fragmenting, amitotic and budding. All these types are figured and are considered as normal, being specialised in connection with some particular metabolic activity. Nuclei of plants infected with virus diseases are, in general, similar to those in normal plants, and are hardly affected by the diseased condition. Intracellular parasites, however, induce much hypertrophy of the nucleus. During periods of special metabolic activity the nuclei of normally healthy plants also become exceedingly hypertrophied and irregular in form. J. L.

Irregular and Fragmented Nuclei in *Tradescantia*.—A. CONARD ("Sur la structure et l'origine des noyaux polymorphes et fragmentés de la tige de '*Tradescantia virginica*' L., ainsi que sur leur division mitotique dans les tissus cicatriciels," *Mem. Acad. Roy. Belgique*, 1928, 9, 1–66). Stems of *Tradescantia virginica* were wounded with a sharp scalpel, and the reparatory tissues studied both in living and fixed material. The technique is described. It is observed that the lobed nuclei enter mitosis without modifying their form. These nuclei are not amoeboid, but having once become lobed, they retain their deformed shape even though they undergo mitosis. A reticulum is present in the regions of the nuclei between the lobes. This is seen in both living and fixed material. The resting nucleus is considered very probably to have a persistent structure extending throughout its volume. On this structure the chromosomes are formed throughout the whole depth of the nucleus. There is no definite organisation of the achromatic figure into a spindle. These deformed nuclei have very irregularly shaped achromatic figures, which fact supports the theory of intranuclear origin of the spindle. Emigration of the chromosomes to two poles is, however, observed. The chromosomes show three distinct variations in structure: (1) constrictions, (2) fragmentation, the fragments remaining opposite one another, (3) fragmentation, the parts becoming separated. Any one fragmented part of a nucleus contains only part of the chromosomal set of the original nucleus. All the fragments in one cell have together the chromosomal set of the original

nucleus. The fragments of a nucleus undergo mitosis. Fragmentation is considered as a regular occurrence which does not alter the function of a cell in *Tradescantia*. It is shown that polymorphism of the nuclei bears a relation to the vigour of the stems. These observations favour the chromosomal theory. A discussion of these results will appear in a future publication. J. L.

The Nucleolus in Zea Mays.—CONWAY ZIRKLE ("Nucleolus in Root-tip Mitosis in Zea Mays," *Bot. Gaz.*, 1928, 86, 402-18). By the use of different fixatives, whose composition and action are described, it is possible to fix: (1) chromatin, plastin (nucleolar material), and mitochondria; (2) chromatin, plastin, and dissolve all mitochondria; (3) plastin and mitochondria, and dissolve the chromatin; (4) chromatin, and dissolve or render unstainable all plastin and mitochondria; and (5) plastin, and dissolve all chromatin and mitochondria. The nucleolar material has thus been separated chemically from the chromatin or the mitochondria and its behaviour investigated unobscured by these substances. In the resting nucleus all chromatin is localised in the reticulum, the nucleolus containing none. It has not been determined whether any strands connect the nucleolus with the reticulum in the living resting nucleus. No such connections exist in bichromate-fixed nor in acetate-fixed material. In early prophase a distinct connection is established between nucleolus and spireme. This is attached to the narrow end of the pear-shaped nucleolus. A double connection is often formed by splitting of the nucleolus. Nucleolar material flows into the spireme. This observation is supported by chemical evidence derived from the fact that, after certain fixatives, nucleolus and spireme core have similar staining reactions. Evidence derived from root-tips fixed with zinc or nickel bichromate is contradictory to the hypothesis of this relationship of nucleolar material and chromatin. The crucial evidence for the nucleolar material entering the spireme is found in cells fixed with nickel-chrome-acetate (pH 5.0-5.2). This dissolves all chromatin and mitochondria, and preserves the nucleolar material, which can thus be seen entering the spireme unobscured. Later, the nucleolus, connected at two places with the spireme, becomes drawn out and finally constricted into two parts which pass to opposite poles of the spindle. The nucleolar material thus enters the daughter cells (1) in the chromosomes, (2) as a distinct body. This latter form reaches the poles first. The nucleolar globules at the poles undergo fragmentation, the majority of the fragments passing into the cytoplasm while the chromosomes are still on the equatorial plate. In telophase the nucleolar material which has been contained in the chromosomes collects into droplets which flow together and form the nucleolus of the resting cell. Nucleolar material is thus continuous, and is derived from previously existing nucleolar material. Some, however, is lost at each cell division by fragmentation and ultimate disappearance in the cytoplasm. Two possible functions of nucleolar material are (1) to transmit the influence of genes to the organism, (2) by means of its electro-positive charge, to serve as a framework for the distribution of chromatin to the daughter cells. J. L.

Nicotiana Hybrids.—R. E. CLAUSEN ("Interspecific Hybridisation in Nicotiana. VII. The Cytology of Hybrids of the Synthetic Species *Digluta*, with its Parents, *Glutinosa* and *Tabacum*," *Univ. Calif. Publ. Bot.*, 1928, 11, 177-211). *Nicotiana digluta*, a species with 36 haploid chromosomes, is considered to have arisen by doubling of the chromosome number in an F_1 hybrid of *N. glutinosa* ($n = 12$) \times *N. tabacum* ($n = 24$) and to have the chromosome constitution $12_{GG} + 24_{TT}$, when GG and TT indicate pairs of *glutinosa* and *tabacum* chromosomes respectively. When used as the female parent, *digluta* readily gives hybrids with

its parental species. The reciprocal crosses are unsuccessful. The *digluta-glutinosa* hybrids are of constitution $12_{aa} + 24_{\pi}$, while the F_1 *digluta-tabacum* exhibit $24_{\pi} + 12_{\alpha}$ chromosomes. In meiosis of both hybrid types the univalent chromosomes usually divide only at the homotypic division. F_1 *digluta-tabacum* is highly fertile in contrast to F_1 *digluta-glutinosa*, from which only few seeds and no progeny have been obtained. F_1 *digluta-tabacum* ♀ × *tabacum* ♂ produce plants all of which belong to the chromosome series $24_{\pi} + n_{\alpha}$, the value of n varying from 0-8. This variation in number of univalents arises through elimination of the univalent G chromosomes in meiosis in F_1 *digluta-tabacum*. A variable number of microcytes is contained in the pollen groups of the various hybrids in addition to four normal microspores. These microcytes are the result of extensive chromosomal elimination. Many excluded chromosomes are not incorporated in the microcytes. It is contended that chromosomal elimination plays a leading part in the determination of gametic series when univalents are present in plants. Of 14 plants of F_2 *digluta-tabacum*, 13 belong to the $24_{\pi} + n_{\alpha}$ series, n valuing from 1-6, and one is of $25_{\pi} + 2_{\alpha}$ constitution. F_1 *digluta-tabacum* ♀ × *digluta* ♂ gives a progeny belonging to the series $m_{\pi} + n_{\alpha}$, with m equal to or greater than 24 and $m + n = 36$. Although a distinct species in its behaviour, it is considered improbable that *digluta* could survive under natural conditions unless isolated from the parental species.

J. L.

Datura.—ALBERT F. BLAKESLEE ("Genetics of *Datura*," *Verhandl. V. Internationalen Kongresses Vererbungswissenschaft, Berlin, 1927. Supp. band 1 Zeitschrift induktive Abstammungs- und Vererbungslehre, 1928, 117-30*). The author summarises the work on the genetic behaviour of *Datura Stramonium* up to 1927. A complete bibliography is given. The paper concludes with a preliminary report of the results of investigations in respect to pollen abortion and associated chromosomal configurations.

J. L.

Double Coloration of Bacteria and Chondriosomes.—P. F. MILOVIDOV. ("Sur la question de la double coloration des bactéries et des chondriosomes," *Compt. rend. séances Soc. biol.*, 1928, **98**, 555-8). Details are given of the methods employed for fixing and staining material for observations on the chondriome and symbiotic bacteria in *Dioscorea bulbifera* and *Lupinus albus*. Nitrogen fixing bacteria are found in the intercellular spaces of the leaves of *D. bulbifera* and in the root tubercles of *L. albus*. These bacteria are almost spherical or shaped as short rods. The intracellular mitochondria are of filamentous form and clearly distinct from bacteria by their staining reactions as well as their shape and position. Using the technique described, the following results are obtained: bacteria blue, chondriosomes red; bacteria green, chondriosomes red.

J. L.

Anatomy and Histology.

Micellar Structure of the Cell Wall.—A. FREY ("Über die Intermicellar-räume der Zellmembranen," *Ber. deutsch. bot. Ges.*, 1928, **46**, 444-56, 6 figs.). The micellæ of cellulose fibres in the air-dry condition or in absolute alcohol are so close as to be almost touching. The actual distance apart is found, by the perfected optical method, to be about 1 p.c. of the thickness of the membranè, which lies very near the limit of measurement. In the water-saturated condition the intermicellar distance in ramie fibres is about 12 p.c. of the wall thickness. As a result of swelling, the micellæ show a slight deviation from the parallel arrangement which characterises the dry state. By the application of a more powerful swelling agent ($ZnCl_2$) the deviation from the straight is increased. Measurements show

that lignification has no effect on the anisotropy of the membrane. It is conjectured that lignification is an irreversible swelling process which may be brought about in response to strong external pressure. It is pointed out that the first signs of lignification in the young plant are seen in the vessels and tracheids which are subjected to lateral pressure by the turgid cells of the ground tissue. Secondary xylem elements which are subjected to mechanical pressure (Druckholz) are more strongly lignified than elements under tension (Zugholz). It is suggested that the slight lignification of the xylem elements of water plants may be connected with the relatively small pressures which their tissues are required to resist.

B. J. R.

Molecular Structure of the Cell Wall.—O. L. SPONSLER ("The Molecular Structure of the Cell Wall of Fibres. A Summary of X-ray Investigations," *Amer. Journ. Bot.*, 1928, 15, 526-36, 7 figs.). X-ray diffraction patterns prove the existence of structural units in the cell wall of ramie (*Bahmeria nivea*) and other fibres. These units are arranged regularly in layers in the wall; some of the layers extend lengthwise of the fibre and some crosswise at various angles. From the diffraction patterns the distances between the layers were computed and a space lattice constructed from which the dimensions of the structural units were determined. The evidence indicates that the structural units are $C_6 H_{10} O_5$ groups joined together in chains which extend lengthwise of the fibre, parallel to one another and very uniformly spaced. There now seems to be no necessity for assuming the existence of micellæ—large units made up of many molecules—as structural units of the cell wall. It is believed that the units described do not exert any appreciable influence on the forms of visible markings seen under the microscope; the size of the units is such that between 2,000 and 3,000 chains laid side by side would be required to make up a cell wall only one micron in thickness. It is suggested that visible markings on the cell wall are due to local protoplasmic activities rather than to individual peculiarities of the $C_6 H_{10} O_5$ group of atoms.

B. J. R.

Tier-like Structure in the Cambia of Woody Plants.—M. TAKAMATSU ("On the Arrangement of Cambial Cells in Some Woody Plants," *Sci. Rep., Tohoku Imp. Univ.*, 1928, series 4, 3, 615-24, 2 pls.). Tier-like or storied arrangement of woody elements necessitates, as a matter of course, a similar arrangement of the cambial cells. The reverse does not hold true, as the tier-like structure may be disturbed by growth in length of the elements cut off by the cambium. The arrangement of the cambial cells was investigated in 150 species belonging to 50 families found in the vicinity of Sendai, Japan. Four types of cambium were distinguished: (1) regularly stratified cambium, having all the cells arranged quite regularly in horizontal series; (2) slightly stratified cambium, a transitional form from type 1 to type 3; (3) non-stratified cambium, having horizontal arrangement of the cells no longer perceptible; (4) irregular cambium. The species in each of the four types are set out in tabular form, with the average length of the cambial cells in each species. The cells are shortest in regularly stratified cambia and increase in length with the irregularity of the arrangement—that is, type 1 has the shortest and type 4 the longest cells. The results of this investigation coincide fairly well with those of former authors. Highly specialised families of dicotyledons generally have regularly stratified cambia, but in certain families of higher dicotyledons, as in Caprifoliaceæ, Celastraceæ, Oleaceæ, Styracaceæ, the cells are non-stratified, while in certain lower families, as in Lardizabalaceæ, the arrangement is regular.

B. J. R.

Wood Structure of *Pinus insignis*.—M. B. WELCH ("Some Mechanical Properties of Australian Grown *Pinus insignis* (*P. radiata*), with Notes on the Wood Structure," *Journ. Roy. Soc. of N.S.W.*, 1927, **61**, 354-70, 5 pls., 2 figs.). The author records the results of investigations on the mechanical properties and wood structure of *Pinus insignis* grown in different parts of Australia. The species belongs to the pitch pine group, having reticulate thickenings on the inner walls of the ray tracheids and one to three, rarely five, ray parenchyma-tracheid pits to each vertical tracheid. The dimensions of the cells and the variation in the gross structure of the growth rings in wood from different localities are given, and the relations of these characters to the mechanical properties of the timber are discussed.
B. J. R.

Wood Structure of the Juglandaceæ.—D. A. KRIBS ("The Wood of *Carya tonkinensis* H. Lecomte," *Trop. Woods*, 1928, **16**, 50-2). The description of this wood is supplementary to the same author's paper, "Comparative Anatomy of the Woods of the Juglandaceæ" (*Trop. Woods*, 1927, **12**.) The wood of this species differs in several important characters from that of the North American hickories and shows affinities to *Juglans* and *Platycarya*.
B. J. R.

Accessory Bundles in *Lobelia*.—R. HOLROYD ("Medullary Bundles in *Lobelia puberula*," *Amer. Journ. Bot.*, 1928, **15**, 442-7, 3 figs.). Accessory medullary bundles representing leaf-traces which penetrate the stem are present in *Lobelia puberula*, for which they probably constitute a diagnostic feature. The bundles are developed from the primary meristem in connection with the habit of the plant of perennially carrying food to the caudex. They consist chiefly of typical phloem tissue. Later a periphloic cambium develops which cuts off metaxylem on the outside.
B. J. R.

Schizocotyly in Ranunculaceous Seedlings.—E. W. MILLER ("On the Occurrence of Schizocotyly in Certain Ranunculaceous Seedlings," *Trans. Bot. Soc., Edin.*, 1928, **30**, 21-36, 4 figs.). Anatomical investigation of seedlings with three cotyledons showed all stages of schizocotyly, including complete tricotyly. An unusually large proportion of such seedlings was found in a sowing of *Delphinium cashmirianum*. Single tricotyledonous specimens of *Thalictrum minus* and *Nigella damascena* were also obtained. The vascular structure may lag behind the division of the cotyledons, at least one symmetrical tricotyledonous seedling with a diarch root being observed. The extravascular elements are invoked by the division of the cotyledon. According to the time and degree of fission of the cotyledon, there are three possibilities for the behaviour of the new vascular tissue of the extra cotyledon: (1) It may unite with the vascular strand of the other part of the cotyledon above the internal collet; (2) it may make contact with the corresponding pre-existing root pole (below the internal collet); or (3) it may itself form a new root pole, as happens when the fission is very early. Once a cotyledon has divided, the further growth of the extra cotyledon depends on the number of vascular elements formed in response to this division. If few are formed, the cotyledon remains undersized; if many, it is normal in size. Schizocotyly stands midway between dicotyly and polycotyly, and as in the angiosperms the primitive structure is probably dicotyly, schizocotyly represents the course of evolution from dicotyly to polycotyly.
B. J. R.

Siliceous Deposits in the Endodermis of Andropogoneæ.—G. BORISSOW ("Weiteres über die Rasdovskyschen Körperchen," *Ber. deutsch. bot. Ges.*, 1928, **46**, 463-80, 4 pls., 1 fig.). Further studies on the siliceous bodies

previously described as occurring in the root endodermis of certain *Andropogoneæ*. Their structure, development and distribution in five further species are described, viz., *Andropogon argenteus* Ell., *A. halepensis* Brot., *A. formosus* Klotsch, *Sorghum vulgare* Pers. var. *sudanensis*, and *Eulalia japonica* Trin. B. J. R.

Artificial Crystals in Preserved Tissue of Mesembryanthemum.—C. I. KEAN (*Trans. Bot. Soc., Edin.*, 1928, 30, 43–5, 1 pl.). It was observed that, after immersion for about two weeks in 90 p.c. alcohol, crystals appeared in the aqueous tissue of the leaves of *Mesembryanthemum*. These were of two kinds: (1) aggregate sphærocrystals composed of elongated rectangular plates, 0.15 mm. in length, and (2) cubic crystals. The former are soluble in water and are of calcium uralite; the latter are insoluble in water and are of calcium phosphate. B. J. R.

Light Receptors in Mesembryanthemum.—C. I. KEAN (*Trans. Bot. Soc., Edin.*, 1928, 30, 37–42, 2 figs.). Species of *Mesembryanthemum* may be divided into two types: (1) where there is a layer of very small crystals of calcium oxalate in the outer wall of the epidermis, and (2) where no crystal layer is formed. *M. inflexa*, of the former type, is characterised by having translucent spots uniformly distributed over both surfaces of the leaf. Large colourless cells, ovoid or bi-convex in shape, occur throughout the mesophyll, separated from the epidermis usually by the outer palisade layer and from each other by the width of six chlorophyllous cells. The cell-sap in these large cells is highly mucilaginous and contains a weak solution of tannin. The absence of chloroplasts gives the translucent appearance to the circular spots visible on the surface of the leaf. A variation of this feature occurs in *M. tigrinum*. In these two species the epidermal cells have the same average size over the whole surface. In *M. glomeratum* there are typical small hexagonal epidermal cells intermixed with large circular protuberant cells. The crystal layer in the epidermis is confined to these large cells, which are situated above the tannin sacs. In *M. verruculatum* the epidermis has features similar to those in *M. glomeratum*, but there are no tannin sacs in the mesophyll. An elaboration of this type occurs in *M. crassulinum*. Other species show either protuberances of some or all of the epidermal cells, or the presence of sub-epidermal tannin sacs. Experiments were made to prove that these special modifications are ocellar and act as light receptors. B. J. R.

Preparing Sections of Cotton Fibres.—J. KISSER and D. B. ANDERSON ("A Method of Preparing Thin Cross and Longitudinal Sections of Cotton Fibres, and its Importance in Cell Wall Research," *Amer. Journ. Bot.*, 1928, 15, 437–41, 1 fig.). A method of manipulating cotton fibres and embedding in celloidin and paraffin is described. Sections should be cut with the knife edge at an angle of about 15° and as sharply inclined as possible. The blade should be moistened with a dilute solution (0.1–0.5 p.c.) of gelatine in water. B. J. R.

CRYPTOGAMS.

Pteridophyta.

Filicales.—"The Ferns (Filicales) Treated Comparatively with a View to their Natural Classification. Vol. III.—The Leptosporangiate Ferns," *Cambridge Univ. Press*, 1928, viii, 304, frontispiece and figs. 581–755). This is the third volume of the author's long investigation of the Filicales. The previous volumes treated respectively of (1) the criteria of comparison to be employed, and (2) the Eusporangiatæ and other relatively primitive ferns; and now the Leptosporangiatæ

are brought under review, and an attempt is made to indicate the phyletic affinities of the principal groups of ferns, in view of their morphology, the nature of their sori, sporangia, etc. Starting from the Schizæaceæ and passing on through the Dicksoniaceæ, we are led on to the Davallioid ferns (*Davallia*, *Nephrolepis*, *Lindsaya*, etc.) and the Pteroids. Starting from Osmundaceæ, we are led through *Plagiogyria* to the Gymnogrammoids (*Onychium*, *Jamesonia*, *Gymnogramme*, *Adiantum*, *Pellæa*, *Cheilanthes*, *Notholæna*, etc.). Starting from *Gleicheniaceæ* and proceeding through *Metaxya* and Cyatheaceæ, we come to the Blechnoids (*Blechnum*, *Stenochlæna*, *Woodwardia*, *Phyllitis*, etc.), and to the Dryopteroids (Woodsieæ, Aspidieæ), Asplenoids, and Onocleoids. Another offset from *Gleicheniaceæ* is through Dipteridaceæ to the Dipteroids (*Cheiropleuria*, *Platynerium*, *Pleopeltis*, etc.).

A. G.

Ferns of Surinam.—O. POSTHUMUS ("The Ferns of Surinam and of French and British Guiana," *Jahn's Drukkerij, Malang, Java*, 1928, i-iv, 1-196). A list of the ferns of Surinam, with inclusion of all species recorded for British Guiana and French Guiana which lie to the west and east respectively. For arrangement and nomenclature Christensen's *Index Filicum* has been followed. Keys to the genera and species are provided. The descriptions are in English. Localities, collectors, specimen numbers are cited, also the herbarium in which the material is preserved, for the author examined the principal herbaria of Europe for records. General remarks on the fern flora of the territories concerned are given at the end of the list. The book is privately published.

A. G.

Bryophyta.

Fossombronia.—L. LOESKE ("Fossombronia Fleischeri Osterwald," *Verh. Bot. Verein Prov. Brandenburg*, 1928, 16, 125-7, 1 pl.). A new description and figures of *Fossombronia Fleischeri*, published by Prof. K. Osterwald in an obscure periodical twenty years ago. This hepatic was discovered at Ausstich bei Buch, near Berlin, in company with *Haplomitrium Hookeri* and *Fossombronia incurva*. The eight excellent figures of the habit of the plant were drawn by Dr. Max Fleischer.

A. G.

American Frullaniaceæ.—FR. VERDOORN ("Ueber einige amerikanische Frullaniaceæ," *Ann. de Crypt. exot.*, 1928, 1, 213-20, 1 fig.). *Frullania jamaicensis*, described by Stephani in 1911, is discussed, and is shown to be a sub-species of *Jubula Hutchinsiae* (Hook.) Spruce, identical with *J. bogotensis* Steph., having a distribution from Columbia to Mexico. The author also discusses *Frullania replicata* Nees, a South American species, and *F. nodulosa* Nees, a species of the Eastern tropics, and shows how difficult it is to separate them, the distinctive characters given in Stephani's *Species Hepaticarum* being incorrect.

A. G.

Mosses and Their Environment.—ADRIEN DAVY DE VIRVILLE ("L'action du milieu sur les mousses," *Rev. Gén. de Botanique*, 1927, 39, 364-83, 449-57, 515-22, 560-89, 638-62, 711-26, 767-83; 1928, 40, 30-44, 95-110, 156-73, 18 pls., 190 figs.). This study of the effect of environment upon the growth of mosses is divided into chapters as follows:—Introduction with history and bibliography; polymorphism of mosses in natural conditions; study of the action of light; of temperature; of the hygrometric state; of aquatic life; of subterranean life; general conclusions. There is very great analogy between the variation of mosses in nature and those which can be obtained artificially in the laboratory. It is found, for example, that the peculiarities of cavernicolous mosses are produced only by the very special

conditions of cavern life. The separate study of each of the factors concerned has shown that sunshine was always more or less unfavourable to the development of mosses, even the most heliophilous species. Rising temperature soon becomes injurious, especially if continuous. The very character which gave rise to the specific name of a moss may be obliterated by the action of these factors; thus, in darkness, in water, or underground, the leaves of *Mnium undulatum* lose their wrinkles, *Racomitrium lanuginosum* its woolliness, and *Hypnum cuspidatum* and *H. squarrosum* have leaves which are neither cuspidate nor squarrose; the leaves of *Polytrichum* lose their lamellæ, which are so important for the determination of the species; *Thuidium tamariscinum* loses all resemblance to *Tamarix*; the characteristic hypodermis of such mosses as *Aulacomnium palustre* disappears almost entirely, and the long flexuose cells of Hypnaceæ shorten and become unrecognisable. On the other hand, *Anomodon viticulosus* is but little altered, and *Leucobryum glaucum* not at all.

A. G.

Moss Leaves.—CH. DOUIN ("Nouvelles observations sur la feuille des mousses," *Rev. Gén. de Botanique*, 1928, 40, 65-87, 2 pls.). In most mosses with nerved leaves the apical cell of the stem is a three-sided pyramid which splits off three segments in constant succession. The first segment formed from a primary segment is the primitive basilar initial of the moss leaf, and in nerved mosses divides tangentially into two cells, or two layers, which become the basilar initials of the lamina and of the nerve. The leaf is composed of cells primarily arranged in ranks, which in the upper part of the leaf become altered by secondary multiplication. The nerve proper comprises only cells situated beneath the lamina, but, as commonly understood, it includes also the cells that cover it above. In nerved mosses the apical cell of the stem splits off angular segments (i.e. segments thicker in the middle), but in nerveless mosses it splits off segments parallel to the sides of the pyramid (i.e. segments of equal thickness throughout, hence the absence of nerve). In many nerved mosses the upper part of a branch is more highly developed than the short basal part, the latter arising from a more primitive basal cell which produces small nerveless leaves, but later is of a higher type and produces normal nerved leaves.

A. G.

Cauline Involucre of Hypnaceæ.—CH. DOUIN ("L'involucre caulinaire des Hypnaceæ," *Rev. Gén. de Botanique*, 1928, 40, 449-55, 6 figs.). The author calls attention to what he calls the cauline involucre of the Hypnaceæ, that is, the group of small protective leaves arranged round the base of each branch. It is a feature proper to the pleurocarpous mosses. The leaves have hitherto been mistaken for paraphyllia, but are in reality true leaves formed exactly like the larger normal leaves of the axis. They even serve to distinguish from one another such closely allied species as *Eurhynchium Stokesii* and *E. prælongum*; in the former the involucre is very distinct and consists of eight or nine acute little leaves, as against three or four rounded leaves in *E. prælongum*. The author discusses the involucre in other types of pleurocarps, and certain other structures connected with these involucreal leaves. The involucre is confined to the pleurocarps, and help to confirm the fundamental difference between pleurocarpous and acrocarpous mosses.

A. G.

Phyllotaxy of Sphagnum.—CH. DOUIN ("La disposition des feuilles et des ramifications chez les sphaignes," *Revue Bryologique*, 1928, 1, 26-35, 1 pl.). The author shows that Schimper was wrong in his memoir on the *Sphagna* in stating that the stems have a phyllotaxy of $2/5$; it is, in fact, $1/3$, corresponding with the

3-sided apical cell; any departure from this is due to torsion of the axis. Further, he shows that Schimper was wrong in saying that a lateral branch arises at the base of every fourth leaf; the fact is that in *Sphagnum* branching takes place by bifurcation only; one branch carries on the axis, the other subdivides and forms a lateral fascicle of branchlets. A. G.

Phyllotaxy of Mosses.—CH. DOUIN ("La disposition des feuilles sur la tige des mousses," *Rev. Gén. de Botanique*, 1928, 10, 641-53, 6 figs.). The author has carefully determined the arrangement of the leaves on the stems of several typical mosses and finds that in Bryaceæ and in Hypnaceæ the divergence is $1/3$ normally, in accordance with the 3-sided apical cell; and when the arrangement is different, it is due to such causes as torsion of the stem, presence of ramifications in the Hypnaceæ, asymmetry of segmentation in the apical cell, differentiation of the initial of the ramifications into a perfect apical cell. A. G.

Pterigynandrum filiforme.—I. THÉRIOT ("Sur le *Pterigynandrum filiforme* (Timm) Hedw. et ses variations," *Revue Bryologique*, 1928, 1, 1-11, 11 figs.). This widely distributed moss species is revised here, and its varieties, nine in number, are defined and figured. Three of these varieties are new to science. A. G.

Splachnobryum.—H. N. DIXON ("*Splachnobryum pacificum* Dixon sp. nov.," *tom. cit.*, p. 12). Description of a new species of moss from one of the Gilbert Islands, on the equator in the Pacific Ocean. It forms a dense dark-green film-like patch on coral rock. It is related to the Queensland species, *S. Baileyi*. A. G.

Pterobryella.—R. POTIER DE LA VARDE ("Fructification de *Pterobryella vagapensis* C.M.," *Revue Bryologique*, 1929, 1, 36-7, 1 fig.). A careful description of the perichætium and fruit of *Pterobryella vagapensis*, hitherto unknown, though the material, abundantly fruiting, was gathered in 1909 in New Caledonia; it has remained hidden in the University herbarium at Rennes. A. G.

Mosses of the Vivarais.—G. DISMIER ("Les Muscinées du Vivarais," *Revue Bryologique*, 1928, 1, 13-25). An account of the mosses and hepatics of the Vivarais, an ancient district of Languedoc now included in the Department of Ardèche. Little was known of its bryology, and Dismier divides it into two regions—Bas Vivarais, with climate and moss flora of Mediterranean type, and Haut Vivarais, with subalpine climate and long winters. He records 14 hepatics and 51 mosses for Bas Vivarais, and 25 hepatics and 73 mosses for Haut Vivarais, with critical notes here and there. A. G.

Iberian Bryology.—PIERRE ALLORGE ("Notes sur la flore bryologique de la péninsule ibérique," *Revue Bryologique*, 1928, 1, 53-8). A list of 19 hepatics and 70 mosses collected by Roger Heim on the Cantabrian chain, in the north of Spain, in August 1926. The Picos de Europe are principally of calcareous rock, rising to over 7,000 ft., while the second range explored, Peña Labra and Pico de Tres Aguas, is essentially siliceous, and has an elevation slightly less. From the latter range no bryophytes had been recorded previously, while on the former range E. Levier had collected mosses in 1878-9. Several additions are here made to the moss flora of the peninsula. A. G.

Mosses of the Far East.—R. HENRY ("Mousses d'Extrême-Orient," *Revue Bryologique*, 1928, 1, 41-8). A list of 71 mosses mostly from Tonkin, from five collectors, with descriptions of nine novelties. The most interesting of the latter

are two new species each of *Pseudorhacelopus* and *Rhacelopodopsis*, previously monotypic genera recorded only from the Philippines and Japan respectively. In the list 34 entries are new records for Indo-China, and 28 others represent new localities for species already recorded. A. G.

Mosses of South Asia.—R. POTIER DE LA VARDE ("Mousses nouvelles de l'Asie méridionale," *Ann. de Crypt. exot.*, 1928, 1, 279–83, 3 figs.). Descriptions and figures of three new mosses—*Campylopus Alleizettei* and *Vesicularia Demangei* from Tonkin, and *Trichostomum perannulatum* from South India. A. G.

Thallophyta.

Algæ.

Diatomite.—V. L. EARDLEY-WILMOT ("Diatomite: Its Occurrence, Preparation and Uses," *Canada: Dept. of Mines, Ottawa*, 1928, no. 691, viii, 182, 15 pls. and map). An account of the origin and occurrence and distribution of diatomaceous earths in Canada, their preparation for economic purposes, the commercial purposes to which they are applicable. On plate I are shown 34 typical forms of diatoms found in the strata. Other plates show several microscope samples of diatomaceous deposits. Others, again, show quarries and methods of working the deposits. A. G.

Phormidium.—P. FRÉMY ("Phormidium rubro-violaceum" (Cr.) Gom., sp. ined., *Ann. de Crypt. exot.*, 1928, 1, 284–7, 1 fig.). A description of this alga, which was collected half a century ago on madrepores on the coast of Guadeloupe. The manuscript notes of Crouan and of Gomont are cited. The filaments are agglutinated, and the sheaths are more or less converted into mucus, by which characters the genus *Phormidium* is characterised. In a short key the relationships of the present alga with its congeners are made evident. A. G.

Anabæna.—M. KOCZWARA ("Anabæna Scheremetievii Elenk. we florze sinic Polski," *Kosmos*, 1927, 52, 562–4, 1 fig.). A blue-green alga, *Anabæna Scheremetievii*, has been found near Lwow (Lemberg). The trichomes occur either free-swimming or combined in a gelatinous layer with *A. flos-aquæ*. The cell measurements are given. A. G.

Spanish Freshwater Algæ.—PEDRO GONZÁLEZ GUERRERO ("Más datos ficológicos de agua dulce," *Bol. R. Soc. Española de Hist. Nat.*, 1928, 28, 435–8, 6 figs.). Descriptions of two new species of blue-green algæ, *Nodularia Skujæ* and *Anabænaopsis Cuatrecasasii*, with critical notes on their affinities. The former plant was found on trunks of elm and poplar, and the *Anabænaopsis* is distinguished by its echinulate spores from all other species of the genus, and from *Anabæna echinospora* by the fact of the vegetative cells being larger than the heterocysts and not rotundate, also by the spines of the spores being opaque, apart from the difference in dimensions. A. G.

Caulerpa Ollivieri.—RODOLPHE DOSTAL ("Caulerpa Ollivieri n. sp., la seconde espèce européenne des Caulerpacées," *Bull. Inst. Océanographique*, 1929, no. 531, 1–12, 1 fig.). A description of *Caulerpa Ollivieri*, a new species of *Siphonææ*, found near Villefranche-sur-Mer, Juan-les-Pins, and Beaulieu, on the French Riviera. Though growing sometimes with *C. prolifera*, it is quite different from that species and its varieties, and bears fronds which are but one-fifth the length and proportionally narrow. In dimensions it corresponds nearly with

those of *C. parvifolia* Harvey from New South Wales. Many observations and experiments are described which were intended to test whether in nature or in artificial conditions *C. Olivieri* passes into *C. prolifera* or *vice versa*, but no proof of that could be obtained. A. G.

Polarity of Caulerpa.—R. DOSTAL ("Zur Vitalfärbung und Morphogenese der Meeressiphonien," *Protoplasma*, Leipzig, 1928, 5, 168–78, 1 fig.). An account of experiments with *Caulerpa prolifera*—the staining of the living plant, and the cultivation of portions of the plant after injury. The living *Caulerpa* cell can be stained with neutral red and a few other dyes, but the colour is soon lost again during culture in pure sea-water. Therefore neither could Steinecke's results concerning the polarity of the cell be confirmed, nor the mutual dependence of the separate parts of the cœnocyte be demonstrated. As to the assumption of a migration of morphogenetically specialised meristemoplasma, this is disproved by the results obtained by the usual experimental morphological methods, which indicate that the cœnocytic *Caulerpa* broadly agrees with the cell-divided higher plants in the causality of the formation of its members. A. G.

Nitella and Alcohol.—P. A. DAVIES ("Effect of Alcohol on Cells of *Nitella flexilis*," *Bot. Gaz.*, 1928, 235 9, 1 fig.). Gives the results of experiments made with solutions of ethyl alcohol upon *Nitella flexilis*; the immediate effect is to produce an initial rise in the production of CO_2 , followed by a fall. On a chart are shown in comparative curves the effects of solutions of 10, 20, 30, 40, 60, 95 p.c. The 20 p.c. solution caused the highest initial rise. The fall of the curve was quickest with the 95 p.c. solution. The high initial rise caused by the 20 p.c. solution is due to a rapid penetration of the alcohol without a rapid change in the cell structure, allowing a rapid outflow of CO_2 . A. G.

Fungi.

Maize-Root Pythium.—CHARLES DRECHSLER ("Pythium arrhenomanes n. sp., a Parasite Causing Maize-Root Rot," *Phytopathology*, 1928, 18, 873–5). The fungus in question is in some particulars similar to the root *Pythium* of sugarcane of Hawaii. The one on maize rootlets was collected in Wisconsin and Illinois. Later collections from Kentucky were found to resemble the Wisconsin fungus. Full microscopic descriptions of the fungus are given and a diagnosis of the new species. A. L. S.

Study of Phytophthora.—D. C. COOPER and C. L. PORTER ("Phytophthora Blight of Peony," *Phytopathology*, 1928, 18, 881–99, 1 pl., 5 text-figs.). The writers have decided that the causal organism of peony blight is a new species, *Phytophthora Pæoniæ*. They have made a cultural and morphological examination of the parasite, which was reported first in 1921. It attacks the stems, leaves, and buds, but is most noticeable as a tip disease. The mycelium is intercellular, with haustoria that penetrate the host cells; it invades the cortex, medullary rays, and pith. No spores were found in the host tissue. Oogonia and antheridia were produced on long hyphæ; conidia were short and broad; spores also were produced. The new species is most nearly allied to *Ph. cactorum*, from which it differs in the form and size of the haustoria, etc., and also in the fact that *Phytophthora cactorum* failed to inoculate the peony. A. L. S.

Study of Achlya prolifera.—TAKÉWO HEMMI and TAKUJI ABE ("An Outline of the Investigations on the Seed and Seedling Rot of Rice Caused by a Watermould, *Achlya prolifera* Nees," *Jap. Journ. Bot.*, 1928, 4, 113–23, 1 pl.). The

writers explain that rice is grown first in nursery-beds which are most commonly covered with water. Under the water the seeds and seedlings are frequently attacked by *Achyla prolifer*. The fungus was carefully studied in pure cultures and tested as to its relations to temperature, to oxygen and hydrogen-ion concentration. The data furnished by dry weight gave the greatest amount of growth at a temperature of 16° or 20° C. The fungus grew moderately in the absence of oxygen, and at a pH range between 4.0 and 8.2. Experiments showed that the fungus was parasitic, though not so destructive as was generally considered. The medium in which the fungus grew best was itself unfavourable to the growth of the rice seedlings.

A. L. S.

Study of Classification in Pyrenomycetes.—F. PETRAK ("Ueber *Bagnisiopsis* und verwandte Gattungen," *Hedwigia*, 1928, **68**, 251–90). The paper is chiefly a review and a criticism of a paper by Theissen and Sydow on Dothideales, in which Petrak has found what seems to him to be serious errors of determination and diagnosis. Chiefly he takes up the study of *Bagnisiopsis* and allied genera, which he considers should not be placed among the Dothideales. In another genus, *Dothidina* Theisz. & Syd., he finds an error in spore description of several species; for one species described as a *Dothidina* he creates a new genus, *Pseudothiella*. Another new genus introduced by him is *Pseudothiopsella*. These are all described with full microscopic details. He has amended the genus *Bagnisiopsis* and introduced many species described under other genera. These fungi inhabit leaves of Melastomaceæ and other trees.

A. L. S.

Life-History of *Erostrotheca multiformis*.—G. HAMILTON MARTIN and VERA E. CHARLERI ("Preliminary Studies of the Life-History of *Erostrotheca multiformis*, the Perfect Stage of *Cladosporium album* Dowson," *Phytopathology*, 1928, **18**, 839–46, 5 pls.). The new fungus was producing disease on sweet peas (*Lathyrus odoratus*), and the causal organism was found to be identical with Dowson's *Cladosporium album*. No perfect stage of the fungus had been found, but in the imperfect stage it was polymorphic: "In addition to seven distinct stages it formed pseudo-sclerotia." The conidial forms observed belonged to the form genera, *Cladosporium*, *Hormodendron*, *Haplaria*, *Ovularia*, *Pseudofumago*, and *Pseudosaccharomyces*. In suitable culture media perithecia with asci and spores were formed, allied to *Neurospora* or *Melanospora* or to *Sphaeroderma*, but distinct from any of these. Hence the new name *Erostrotheca*. The difficulty of securing the perfect fruiting stage previously was probably due to the presence or absence of certain strains.

A. L. S.

Sclerotinia in North America.—H. H. WHETZEL ("North American Species of *Sclerotinia*. II. Two Species on *Carex*, *S. Duriaana* (Tul.) Rehm. and *S. longisclerotialis* n.sp.," *Mycologia*, 1929, **21**, 5–32, 5 pls., 1 text-fig.). This is the first account of *Sclerotinia* occurring on *Carex* in N. America. Whetzel, who made the first collection in 1918, has thoroughly investigated the species, both in literature and in the laboratory. He concludes that he is dealing with two species, *S. Duriaana* Rehm. and a new species, *S. longisclerotialis*. In the former species he recognises two forms distinguished by the form of the microconidial sporodochia and described by him as *affine* forms, with the sporodochia narrow and linear, and the *ambiens* forms, in which they are short and oval and grouped round the culm. The life-histories of both species have been carefully worked out, and the differences between them in nature and in cultures are described. *S. Duriaana* was most frequently found on *Carex stricta*, *S. longisclerotialis* on *C. prairea*.

A. L. S.

Species of Plectodiscella.—A. E. JENKINS and J. G. HORSFALL ("A Comparison of Two Species of Plectodiscella," *Mycologia*, 1929, **21**, 44-51, 2 text-figs.). A fungus was isolated from specks on the Jonathan apple and after culture was referred to *Plectodiscella Piri*, which was known to occur on leaves of apple or pear. It is compared with *P. veneta*, and might possibly be identical with that species. The morphology and development of the fungus are described.

A. L. S.

Biologic Studies in the Sphæriales, II.—JULIAN H. MILLER (*Mycologia*, 1928, **20**, 305-39, 3 pls.). Miller has devoted this second paper to a study of the dark-spored forms of this order. He considers that species and genera with dark spores show a close relationship; all the members with such well-marked spores should be in Xylariaceæ, thus including in one family *Sordaria*, *Melanospora*, *Rosellinia*, *Anthostomella*, and *Anthostoma*, along with the other genera usually classified in that family. To establish and justify the view he has given, he publishes the results of his examination of the different genera concerned. Fullest attention has been given to the various species of the genus *Hypoxyylon* and chiefly to their development, enabling him thus to trace the contact with other genera and the characters in common. The chief characteristics he discusses are (1) the stroma, (2) development of the perithecium, (3) the perithecial, (4) the conidial fructification. Miller has outlined the results of his work in each of these sections. The family, as emended, contains 10 genera—the family as generally understood with, in addition, *Rosellinia* and *Anthostoma*. *Hypoxyylon* in this scheme includes *Nummularia* and *Ustulina*.

A. L. S.

New Leaf Parasite.—CH. KILLIAN ("Un parasite nouveau des feuilles d'*Aronia rotundifolia* Pers., le *Glæosporium Aroniæ* n. sp.," *Bull. Soc. Mycol., France*, 1928, **44**, 241-8, 2 pls.). The writer discovered the fungus on the shrub *Aronia*, in the Vosges region; the leaves were covered by small black spots, on both surfaces, of various form, ellipsoid and angular. The leaves did not seem to be seriously damaged, but after their fall the whole tissues became filled with the parasite. Killian made cultures of the fungus; he has followed the entire development and spore production, and discusses its systematic position as a true *Glæosporium*.

A. L. S.

Parasitic Leaf Fungus.—G. NICOLAS and MLLE. AGGERY ("Un cyclonium parasite de *Phillyrea angustifolia*," *op. cit.*, 301-3, 1 text-fig.). The parasite formed round dark-coloured spots on the leaves. The mycelium lives in the cuticle of the leaves and of the fruits. Conidia are elongate, coloured, and 1-3-septate. It was found to be a new species, *C. Phillyrea*.

A. L. S.

Studies on Flax Rust.—NAOHIDE HIRATSUKA (*Trans. Sapporo Nat. Hist. Soc.*, 1928, **10**, 1-27. See *Jap. Journ. Bot.*, 1928, **4**, suppl. 33). This rust causes serious damage in the flax region in Japan. The causal fungus is *Melampsora liniperda* (Körn.) Palm. The æcidium belongs to the *Cæoma*-type. The uredosorus is covered by a peridium. Teleutospores germinate in early spring, after 10-17 days æidia are developed. Some strains of the flax are immune or very resistant, others are susceptible to infection.

A. L. S.

Investigations on Sex in the Rust Fungi.—A. H. R. BULLER ("Plants of Canada, Past and Present," *Trans. Roy. Soc., Canada*, 1928, **22**, 55-58). In a presidential address delivered before the Canadian Royal Society, Buller has described, in the pages cited, the work on rusts carried out by J. H. Craigie during

two years, by which has been solved the problem of the function of the pycnidia (and pycnidiospores), usually termed spermogonia. By sowing haploid spores (pycnidiospores) of *Puccinia Helianthi* on the leaves of the sunflower, singly and in pairs, he secured the formation of æcidia—the diploid structure. Other rust experiments gave similar results. The function of the pycnidium, as discovered by Craigie, is to produce pycnidiospores, which being transferred (by insects, etc.) to another pycnidium of opposite sex, a mixed mycelium is developed, the structure passes from haploid to diploid, and æcidia are developed. A. L. S.

Heterothallism in Rusts.—J. H. CRAIGIE ("On the Occurrence of Pycnia and Æcia in Certain Rust Fungi," *Phytopathology*, 1928, 18, 1005–15, 3 text-figs.). The writer has been at work for some time on rusts, and has secured evidence by experimentation that *Puccinia Helianthi* and *P. graminis* are heterothallic, that pustules derived from infections by single sporidia of these rusts never produce æcidia, but when nectar containing pycnidiospores is transferred from one to another pycnidium, æcidia appear in a few days. From the experiments and their results Craigie claims to have established the heterothallic nature in a number of the common rusts, and also to have discovered the function of the useless seeming spermogonia (pycnidia). The nectar from one pycnidium containing sporidia is conveyed to another by flies, etc.; from the intermingling and growth that result there arise a heterothallic thallus and the subsequent æcidia. A. L. S.

Research on Heterœcious Uredineæ.—B. FERNANDEZ RIOFRIO ("Acerca de dos uredales heteroicos," *Bol. Real Soc. Esp. Hist. Nat.*, 1928, 28, 405–10). The author has carried out successfully experimental cultures of *Puccinia obscura* on *Luzula Forsteri*. He has proved that the æcidial stage grows on *Bellis silvestris* and is known as *Æcidium Montagneæ*. In other cultures he has experimented with *Coleosporium Inulæ*, and has been able to relate it to *Peridermium* on the leaves of *Pinus silvestris*. He had found the *Peridermium* on *Pinus halepensis*, a rarer tree, and he thinks the *Coleosporium Inulæ* is capable of parasitizing either tree. A. L. S.

Specialization in Smuts.—H. A. RODENHEISER ("Physiologic Specialization in Some Cereal Smuts," *Phytopathology*, 1928, 18, 955–1003, 18 text-figs.). Physiologic specialisation in fungi was first suggested by Schroeter in 1879. It has an important bearing on the problems of host resistance to parasites. The present investigation includes an account of the cultural differences indicating physiologic forms which occurred in various species of *Ustilago* and *Tilletia*. Experiments were made on the influence of temperature on the cultures, on the pathogenicity of the different forms, and on the varietal resistance of wheats and oats. In the cultures a very large number of physiologic forms were determined; they were distinguished by colour, type of margin, etc. On the other hand, the differences in cultures of *Ustilago Tritici* and *U. nuda* were so slight that the writer considers them as merely physiologic forms of one species. Specimens of cereals and of the fungi were obtained from widely separated countries. The results of the cultures are set out and the conclusions on pathogenicity are given. A list is given of papers dealing with the subject. A. L. S.

Study of Smut Fungi.—SYDNEY DICKINSON ("Experiments on the Physiology and Genetics of the Smut Fungi. Cultural Characters. Part I. Their Permanence and Segregation," *Proc. Roy. Soc.*, 1928, ser. B., 103, 547–55, 1 pl.). In cultural experiments with fungi on artificial media it has been observed that changes take place and new forms arise. The object of the paper is to find out if

these inheritance characters are Mendelian. Experiments were made with the covered smut of oats, *Ustilago levis*. A chlamydospore was isolated and allowed to germinate on a suitable medium. From the sporidia four cultures were obtained, and one of the strains showed characters differing from the others. Its significance and occurrence are discussed. A further paper is in preparation. A. L. S.

Mycological Notes.—E. GILBERT ("Bribes mycologiques," *Bull. Soc. Mycol., France*, 1928, **44**, 225–31). Gilbert suggests, in the first place, that attention should be paid to position of the mature spores on the basidium—a character which might well be used in classification. Special attention is directed to the white "powder" that covers the hymenium of *Ganoderma applanatum*. Several suggestions have been made as to the origin of this spore layer, but Gilbert and others conclude that the spores are really the product of the basidia. Observations were made on the effect of moisture on spore production. A. L. S.

Congo Fungi.—M. BELLI ("Contribution à la flore mycologique du Congo belge. Fungi Goossensiani V," *Bull. Soc. Roy. Bot. Belgique*, 1928, **60**, 153–71, 3 pls.). The paper deals entirely with Hymenomycetes, and is based on a fine series of drawings made by Madame Goossens during her sojourn in the Congo. A fair number are well-known more or less cosmopolitan species; many, however, are new to science. Of these, 55 figures represent the form of the fungi in outline, taken from Madame Goossens' drawings. Locality, habitat, and date of collection are given. A. L. S.

Psalliota Cultures.—F. C. STEWART ("Is *Psalliota brunnescens* under Cultivation?" *Mycologia*, 1929, **21**, 41–3, 2 pls.). The fungus in question grew from a culture of "American spore culture mushroom, cream-white variety." The mushrooms developed were reddish-brown, scaly, and usually of large size. They were identified as *Psalliota brunnescens*, which is rare in the wild state, and not hitherto known to be cultured for mushroom spawn. A. L. S.

Disease Reaction of Fungi.—TAKAWO HEMMI and FUSATARO SETO ("Experiments Relating to Stimulative Action by the Causal Fungus of the 'Bakanæ' Disease of Rice," *Proc. Imp. Acad.*, 1928, **3**, 181–4, 2 text-figs. See *Jap. Journ. Bot.*, 1928, **4**, abstr. 33). A fungus, *Fusarium* sp., was isolated from seeds suffering from the disease of rice called 'Bakanæbyo.' A feature of the disease is that the seedlings become abnormally taller and more slender. A filtrate of cultures given to the plants has proved that it is this fungus that induces the overgrowth of the host plant. A. L. S.

Toxic Action of Fungi.—TAKAWO HEMMI and IOAMU MATSURA ("Experiments Relating to the Toxic Action by the Causal Fungus of Helminthosporiose of Rice," *tom. cit.*, 185–7. See *Jap. Journ. Bot.*, 1928, **4**, abstr. 32). The writers placed rice plant stems in a filtrate of *Helminthosporium Oryzæ* mycelium. Wilting set in, and the experiment proved that it was due to toxic substances excreted by the fungus and not to plugging of the water-vessels by mycelium, as had been supposed. A. L. S.

Vegetable Biology.—P. GAVAUDEN ("Sur la présence d'un champignon parasite dans les antheridies de *Marchantia polymorpha* et son action sur la gametogénèse," *Compt. rend. Acad. Sci.*, 1928, **187**, 995–7). The presence of a fungus parasitic or symbiotic has been frequently noted in the thallus of hepatics. The present note deals with a fungus that had penetrated the antheridia of

Marchantia polymorpha and had sometimes destroyed them. The invasion of the hyphæ takes place before the formation of the spermatia, but all of the antheridia are not attacked. In some instances the fungus developed pycnidia.

A. L. S.

Spanish Microfungi.—A. CABALLERO ("Adiciones a la microflora española," *Bol. Real Soc. Esp. Hist. Nat.*, 1928, **28**, 421–30, 4 text-figs.). The writer publishes a list of microfungi newly found in Spain. Three species of mycetozoa head the list. Species belonging to a wide series of fungi have been collected, and their exact localities and habitats are recorded. Special attention was given to the new genus and species *Fragosia verrucosa* Cab., in which 8-spored asci are borne on a creeping mycelium. Several other species new to science are described.

A. L. S.

Fungi of Dominica.—ROMUALDO GONZALEZ and RAFAEL CIFERRI ("Hongos parásitos y saprofitos de la republica dominicana" (ser. 16), *Bol. Real Soc. Esp. Hist. Nat.*, 1928, **28**, 377–8). The writers describe two species of mycetozoa; they then pass on to Saccharomycetes with a new genus, *Ashbia*, the mycelium of which was found in seeds of *Gossypium*. Several species belonging to Fungi Imperfecti are new to science.

A. L. S.

Formation of Variants in Fungi.—B. BARNES ("Variations in *Eurotium herbariorum* (Wigg.) Link., induced by the Action of High Temperatures," *Ann. Bot.*, 1928, **42**, 783–812, 1 pl., 4 text-figs.). The occurrence of a variation in *Eurotium herbariorum* from coloured to colourless was noted in a colony grown for some time for experimental purposes. The only cause of change that seemed possible was that of temperature. Heating was therefore applied to spores, and the results in the cultures confirmed very largely the supposition. The various culture experiments are fully described, and examples are quoted of variations in other instances that may have been due to heat, though changes may be due also to other factors.

A. L. S.

Effects of Ultra-Violet Radiation on Various Fungi.—F. L. STEVENS (*Bot. Gaz.*, 1928, **86**, 210–25, 12 text-figs.). It had already been proved that ultra-violet radiation had a striking effect on sexual development in various fungi; those that normally produced few fruiting stages showed a profuse growth of reproductive bodies. The research was undertaken to precise the exact influence of the rays. Two fungi were grown on agar plate cultures—*Glomerella cingulata* and a *Coniothyrium* sp. Full details are given as to the nature of the growth media and the method of application of the rays. The immediate effect of radiation on *Glomerella* colonies was the death of the aerial mycelium, the general stunting of the colony, and a very much heightened growth of perithecia. Exact data were worked out as to the lethal dose and also as to perithecial stimulation. Similar experiments with *Coniothyrium* gave the same results—the killing of the youngest mycelium and the abnormal development of pycnidia on the cultures.

A. L. S.

Study of Mycorrhiza.—W. B. McDOUGAL and CHARLOTTE LIEBTAG ("Symbiosis in a Deciduous Forest. III. Mycorrhizal Relations," *Bot. Gaz.*, 1928, **86**, 226–34). The Illinois forest examined contained 183 species of seed plants, 80 p.c. of which were tested as to the presence of mycorrhiza in the roots. Microscopic slides were made of the sectioned root-tips. A list is given of the plants, and mycorrhizal fungi, either ectotrophic or endotrophic, were found in 93 species. Apparently there are few woody plants that do not harbour mycorrhiza. The

writers noted that while in some families, such as Rosaceæ and Compositæ, mycorrhizas are common, in others, Labiatæ and Scrophulariaceæ, they are relatively uncommon. No evidence was found that any of the higher plants profited by the presence of the fungus, though the relation may possibly be mutually advantageous. No evidence of the actual digestion of the fungus filaments was seen. The writers conclude with the statement that the mycorrhizas studied by them should be classified "under antagonistic nutritive conjunctive symbiosis, the fungus being parasitic on the higher plant."

A. L. S.

Investigation of Soil Fungi.—W. B. BRIERLEY, S. T. JEWSON, and M. BRIERLEY ("The Quantitative Study of Soil Fungi," *Proc. & Papers First International Congress of Soil Science*, 1927, 3, 1-24, 7 figs.). The writers have concluded that "the number of soil fungi is legion . . . perhaps few fungi capable of existing saprophytically may not be cultured from soil." The paper deals only with the quantitative technique of mass extraction considered under sampling, suspension, disintegration, dilution, plating, incubation and enumeration. In most soils examined there was a rapid decrease of fungal content downwards, beginning at a depth of 10 to 20 cm., probably related to ploughing and the presence of clay subsoil. The methods of calculating, growing, etc., are fully dealt with, and under "General Observations" the risks of error in the experiments are discussed.

A. L. S.

Use of Fungicides.—E. F. GUBA ("Control of Cucumber Powdery Mildew in Greenhouses," *Phytopathology*, 1928, 18, 847-61, 1 pl.). The author has tested a considerable series of substances—sulphur preparations, hydrocyanic gas, copper sprays, etc. He finds that sulphur preparations are the most effective and safest, either as Bordeaux mixture or as sulphur dust or sulphur sprays.

A. L. S.

Differential Staining of Peronosporaceæ.—E. LEPIC (*Phytopathology*, 1928, 18, 869-72). The author discusses various stains, some, such as cotton blue, being impermanent. He has worked out a solution that stains the mycelial parasite, but not the parasite host plant. It is a question of method chiefly: soaking 10-15 minutes in lactophenol alcohol, then 2 hours in the stain, with subsequent washings and mounting. A permanent satisfactory stain of the fungus alone is thus secured.

A. L. S.

Control of Apple Scab.—R. A. JEHLE and H. A. HUNTER ("Observations on the Discharge of Ascospores of *Venturia inæqualis* in Maryland," *Phytopathology*, 1928, 18, 943-5). The authors have followed the life-history of the fungus *Venturia inæqualis*, the cause of apple scab, in order to make their control measures effective. The practice had been to spray the apple trees during the pink-bud stage. It has been found that the time of danger is that of spore-discharge from the *Venturia* on diseased apple leaves, generally at an earlier stage, and on fallen autumn leaves. It was observed in some cases that spores were discharged from them while the trees were still dormant.

A. L. S.

Fusarium Disease.—KOGO TOGASHI ("Three Fusaria which Cause the Wilt Disease of Pea," *Jap. Journ. Bot.*, 1928, 4, 153-88, 5 pls., 1 text-fig.). Three different species of *Fusarium* have been determined as causing a disease of Alaska pea in the neighbourhood of Tokyo. The first to be studied was *F. sporotrichoides* Sherb., later *F. anguoides* and *F. arthrosporoides* were also found to be causing disease. Numerous inoculation and cultural experiments with the different species were carried out. The first appearance of the fungi is a reddish-brown streak on

the portions of the stem at ground level; later sporodochia appear—yellow in *F. arthrosporoides*, greyish in *F. anguoides*. As a result of inoculation experiments, it was found that though all were parasitic on pea seedlings, they differed in infecting power, *F. arthrosporoides* being the most virulent. The taxonomic characters are tabulated and figured on the plates.

A. L. S.

Lichens.

Lichens from Yunnan.—ROBERT PAULSON (*Journ. Bot.*, 1928, 66, 313–19, 1 pl., 1 map). The lichens were collected by J. W. Gregory and C. J. Gregory during their expedition to the alps of Chinese Tibet in 1922, and were gathered in twenty-six localities under 3,000 and over 16,000 feet altitude. Many of them are from the extreme north-west of Yunnan, “a region of lofty mountain chains trending north to south.” Comparison is made by Paulson between the lichens of the district and those of Sikkim. Nearly all the species, especially those from the higher regions, are alpine in character. A vigorous gall-growth on *Letharia thamnodes* is described.

A. L. S.

Northern Peltigeraceæ.—BERNT LYNGE (“The Peltigeraceæ in the Copenhagen Arctic Herbarium,” *Dansk Bot. Ark.*, 1928, 5, no. 11, 1–13). Three genera, *Peltigera*, *Solorina*, and *Nephroma*, are comprised in this survey of the Western Arctic—Greenland, Iceland, and the Faroes. Lynge gives the collectors and the various localities, with notes on occurrence and biology. Thus *Solorina bispora* has been found “most abundantly on moist soil irrigated by water from melting snow and ice”; *Nephroma arcticum* rare and not typically Arctic, being “much more common and much better developed in the upper forest zone.”

A. L. S.

Corsican Lichens.—JACQUES MAHEU and ABEL GILBERT (“Lichens de l'est de la Corse,” *P. Berthier, Dijon*, 1926, 1–114, 3 pls.). This account of Corsican lichens is preceded by a history of the specimens written by P. A. Genty, Director of the Botanic Gardens, Dijon. The lichens formed part of a collection made by Zschacke, of Bernburg, in the summer of 1914. A consignment to his home address had reached Dijon on the outbreak of war, when the frontier was closed. Finally they were sent to the Dijon Botanic Gardens in 1916, and Maheu and Gilbert, who had already made studies of lichens in Corsica and neighbouring islands, were asked to examine and report. The species enumerated, 300 in all, include many new to Corsica, with five species and six varieties new to science. All these are described, and, as regards the others, habitat and locality are carefully indicated, with frequent notes on individual species. The lichens now recorded for Corsica number 764. Of these, 24 species and certain varieties have not yet been found in France.

A. L. S.

Parasymbiosis in Lichens.—JEAN SCHÆCHTELIN and ROGER GUY WERNER (“Un cas foudroyant de parasymbiose. Le *Homostegia Piggottii* (Berk. & Br.) Karst., son développement biologique et physiologique,” *Bull. Soc. Mycol., France*, 1928, 44, 232–40, 1 pl.). The fungus described grows on the thallus of *Parmelia saxatilis*, more rarely on *Parmelia omphalodes*. It has been collected in Finland, Germany, England and France. The lichen is invaded by the black stroma of the fungus, the spore of which germinates and penetrates the thallus. The hyphæ of the fungus enter into symbiotic relationship with the gonidia, surrounding them, but never penetrating; gradually the lichen hyphal tissue is entirely replaced by that of the fungus. The fungal filaments are easily recognised by their dark colouration. The development of the fungal reproductive organs was followed and

has been described. The writers conclude that there is formed a complete new symbiosis, the *Homostegia* filaments supplanting those of the *Parmelia*. The soredia are also invaded by the intruding fungus and help in its dispersion.

A. L. S.

Polish Lichens.—JINDŘICH SUZA ("Przyczynek do znajomości flory porostów Polski (Additamenta ad lichenes Polonice cognoscendos)," *Acta Soc. Bot. Pol.* (Livre jubilaire), 1928, 5, 213-19). The author has here listed a very considerable addition to the known lichen flora of Poland. Locality and habitat are carefully indicated. *Cladonia* are especially abundant.

A. L. S.

New Species of Lichens from Porto Rico.—E. A. VAINIO (*Mycologia*, 1929, 21, 33-40). The 22 new species described by Vainio form part of a series of 52 lichens submitted to him for examination and determination. They were collected by the late Prof. Bruce Fink. The species are all crustaceous—they grew on rocks and on trees or wood. Two new genera are described—*Finkia*, with a crustaceous thallus, *Glæocapsa* gonidia, gyalectoid apothecia without gonidia, and muriform spores. The other genus, *Gyrocollema*, also crustaceous, but with *Nostoc* gonidia, lecideine apothecia, and simple spores.

A. L. S.

Lichen Distribution.—G. EINAR DU RIETZ ("Gyrophora rigida D.R. in North America. A New Member of the West Arctic Element in the Scandinavian Mountain Flora," *Svensk. Bot. Tidsk.*, 1928, 22, 278-81). Du Rietz pointed out some time ago that the *Gyrophora anthracina* of early writers was a mixed species; he therefore delimited the Scandinavian species as *G. rigida*. The species has a distinctly areolate verrucose under-surface rose-coloured towards the centre and black towards the margin. Two specimens of the same plant have been in recent years collected in N. America—from the Yukon and from the summit of Olympic Mountain in Washington. Hitherto *Gyrophora fuliginosa* was the only lichen known as a member of the West Arctic group of plants to be found in Scandinavia and in N. America. Du Rietz has also enumerated the flowering plants of the group. He considers that *G. rigida* must have survived the glacial period in Scandinavia "on any wind-exposed rock rising above the ice-cover." It is an extreme high-Alpine species hardly ever found below forest-line.

A. L. S.

New Zealand Lichens.—A. ZAHLBRÜCKNER, K. KEISSLER and H. H. ALLAN ("The Epiphyllous Lichens of Kitchener Park, Feilding, New Zealand," *Trans. N.Z. Inst.*, 1928, 59, 304-14). This communication falls into three sections: (A) An ecological account of the leaves that are found to harbour lichens; the main features of the Kitchener Park Forest, which is mainly sub-tropical. A list of the lichen-bearing plants is given, their habitat, growth form, size and texture of leaves, etc. The most common lichen species there is *Lopadium subcærulescens*, which attacks 31 species. The requirements of the lichen plant are also discussed. (B) A description of several new leaf species is provided by A. Zahlbruckner, along with a list of several already known to science. (C) An account is given by Keissler of a new species of lichen parasite, *Chlorocyphella lichenicola*. It bears considerable resemblance to *Cyphella æruginascens*, and Keissler considers that they may possibly be proved to be development stages of the same fungus, or that the new species may be a stage of the lichen fructification. It was found on the leaf lichen *Lopadium subcærulescens*.

A. L. S.

Dune Lichens.—C. F. E. ERICHSEN ("Flechten des Schutz-gebietes bei Süderlügum," *Beitr. zur Naturdenkmalpflege*, 1928, 12, 303-7). The paper forms the second part of an account of the vegetation of an inland sand dune. The

dune is covered by heather (*Calluna*) and offers small space to lichen growth. Where the soil is more uncovered, the lichens are more abundant. Three shrubby lichens, *Cladonia impeza*, *Cl. mitis*, and *Cl. silvatica*, grow beneath the *Calluna* covering, with others that are less frequent. One of the most notable is *Lecidea uliginosa*, which forms a dark covering over the sand and holds together the sand particles. Several other lichens were noted as pioneers of vegetation. Erichsen determined 42 species, and does not consider that he has exhausted the list. In a previous section of the paper (p. 298), dealing with the higher plants, it is stated that *Cladonia silvatica* may, by its growth, crowd out the plants of *Calluna*.

A. L. S.

Mycetozoa.

Spore Germination in Mycetozoa.—W. R. IVIMEY COOK and E. M. HOLT ("Some Observations on the Germination of the Spores of Some Species of Mycetozoa," *Mycologia*, 1928, 20, 340-51.) The authors determined, first of all, that germination of Mycetozoa spores is uncertain unless definite physiological conditions are secured, also that the time factor must be taken into account. For instance, *Reticularia Lycoperdon* spores germinated in about an hour, while species of the genus *Trichia* required a week. As a rule, sporangia and spores are formed in winter when it is cold. For experimental cultures, 10 different solutions were used, and the effect of light, darkness, and heat was tested. The results differed so widely in the different species that no general conclusions were arrived at. The same species from different localities showed no appreciable difference in the time required for germination. *Reticularia Lycoperdon* retained vitality from five to seven years. *Trichia varia* lost vitality in a year.

A. L. S.

Myxomycetes.—E. JAHN ("Abteilung Myxomycetes," *Die Natürlichen Pflanzenfamilien, zweite Auflage*, A. Engler., 1928, 2, 304-39, figs. 425-47). Jahn has given here an account of our present knowledge of mycetozoa—their vegetative and reproductive characters, with full descriptions of families and genera. Under the section "Reproduction" he discusses the various cytological developments, such as nuclear division, copulation of the amoebæ, dispersion of zoospores, formation of plasmodium, etc. The record of known species reaches about 300, the larger number occurring in temperate regions. The author includes *Chlamydomyxa* as a supplement to the myxomycetes. It develops as plasmodium, with thread-like pseudopodia and with a cellulose membrane, in the cells of *Sphagnum*, dead grasses, etc., and contains chlorophyll-green chromatophores. Two species—one from Ireland—have been recorded.

A. L. S.

Moldavian Mycetozoa.—MARCEL BRANDZA ("Les myxomycètes de Neamtz (Moldavie)." *Bull. Soc. Mycol., France*, 1928, 44, 249-300, 4 col. pls., 2 text-figs.). The writer here sets down the work of 12 years. The region of exploration in search of mycetozoa is, he tells us, of small extent, roughly a circle of about 6 kilometres diameter. Much of it is forest land of mixed conifers and deciduous trees. The prevalent humidity and the abundance of trees blown down by storms affording favourable conditions for the growth of mycetozoa. Brandza comments on the cosmopolitan nature of the organisms. He found a species, *Physarum pulcherrimum*, previously recorded from America, Ceylon, and Malacca, forming a vast colony on rotten pine stumps, and concludes from that and from similar finds that almost any known species may occur in these Roumanian woods. His list includes 181 species, out of a total of 287 known mycetozoa. He has discovered two new varieties. Various observations on periodicity are also recorded. Of

20 lignicolous species, 11 appeared annually, 7 every second or third year, while 2—*Physarum citrinum* and *Lycogala conicum*—observed in 1924 reappeared only in the autumn of 1927. Data as to the occurrence of species on damp leaves are also given, and notes on spore changes that developed during the year after maturity.

A. L. S.

Japanese Mycetozoa.—YOSHIKAZU EMOTO ("Die Myxomyceten gesammelt, 1924–1927, in dem Botanischen Garten zu Tokyo," *Bot. Mag., Tokyo*, 1928, 42, 196–203, 2 text-figs. See *Jap. Journ. Bot.*, 1928, 4, abstr. p. 31). The writer has given a list of 75 species collected in the Botanical Garden at Tokyo. A new species, *Arcyria nigella*, is described and figured.

A. L. S.

Mycetozoa in Norfolk.—H. J. HOWARD ("The Mycetozoa—their Life-History and the History of their Study, together with Notes on their Occurrence in Norfolk," *Trans. Norfolk and Norwich Nat. Soc.*, 1927–28, 12, 384–413, 3 pls.). The above paper was prepared by H. J. Howard as a presidential address for the Society. The author surveys the history of the study from the first reference by Panckow in 1654 down to the present day. He also surveys the gradual discovery of stages in the life-history of the organisms. De Bary first called them mycetozoa, and discovered the peculiar spore germinations, resulting in swarm cells and amoeboid bodies. Howard has recapitulated the main features of their development, through their many phases, from spore to spore, and notes the great variety of form and colour both in the plasmodium and in the sporangial stages. He discusses their cosmopolitan distribution and their varying habitats on stumps, dead leaves, etc. The number of known species is about 300, and of these, 195 have been found in Great Britain and Ireland. A full account is given of the 121 species of mycetozoa in Norfolk, with a description of the county, conditions, temperature, rainfall, etc. Biological notes are added to the enumeration of the species. Finally a comparative table has been drawn up representing their occurrence in Norfolk and other districts, all of which have been well worked.

A. L. S.

NOTICES OF NEW BOOKS.

Catalogue of Shop-Soiled and Second-Hand Instruments and Apparatus at Reduced Prices.—Nov. 1928. 35 pp., 9 figs. Published gratis by Ogilvy & Co., 20, Mortimer Street, London, W. 1.

Microscope Record.—No. 16. January, 1929. 32 pp. Published gratis by W. Watson & Sons, Ltd., 313, High Holborn, London, W.C. 1.

Practical Bacteriology.—By FRED W. TANNER, Ph.D. 1928. xiv, 235 pp., 67 text-figs. Published by John Wiley & Sons, Inc., New York, and Chapman & Hall, Ltd., 11, Henrietta Street, Covent Garden, London, W.C. 2. Price 12s. 6d.

Laboratory Manual of General Microbiology.—By E. B. FRED, Ph.D., and S. A. WAKSMAN, Ph.D. 1928. viii, 145 pp., 18 text-figs. Published by McGraw-Hill Publishing Co., Ltd., 6 and 8, Bouverie Street, London, E.C. 4. Price 10s.

Handbook of Microscopical Technique.—Edited by C. E. McCLUNG, Ph.D. 1929. xiv, 495 pp., 43 text-figs. Published by Paul B. Hoeber, Inc., New York, and Humphrey Milford, Oxford University Press, Amen House, Warwick Square, London, E.C.4. Price 36s.

Manual of Helminthology.—By H. A. BAYLIS, M.A., D.Sc. 1929. xi, 303 pp., 200 text-figs. Published by Baillière, Tindall & Cox, 7 and 8, Henrietta Street, Covent Garden, London. Price 30s.

The Spectroscopy of the Extreme Ultra-Violet.—By THEODORE LYMAN, Ph.D. 1928. 2nd Edition. vii, 160 pp., 1 plate, 7 text-figs. Published by Longmans, Green & Co., Ltd., 39, Paternoster Row, London, E.C. 4. Price 10s. 6d.

The interest of this book to microscopists is mainly due to the information that is given on the transmission of ultra-violet light by certain liquids and solids. If ultra-violet microscopy develops as it should, then a much fuller knowledge of the properties of quartz and fluorite, for instance, will become essential. The book deals mainly with that part of the spectrum known as the "Schumann Region." This includes radiations not transmitted by air, the observation of which, therefore, can only be carried out by means of a vacuum spectroscope. Whether a vacuum microscope using such radiations will ever be produced, it is yet difficult to say, but in theory such a development is not impossible. To those microscopists who have the imagination to visualise such a method, this book may be commended. It is written by one who is a master of the subject and to whom much of the knowledge it contains must be attributed.

J. E. B.

Etude critique du Transformisme.—By F. CARREL. 1929. 86 pp.
Published by Vigot Frères, 23, Rue de l'Ecole de Médecine, Paris.

The theory of transformism rests on the evidence of embryology and of the geological record. The increasing complexity of the latter in successive ages strongly suggests that the living species of one age are directly descended from those of the previous age. For the author this assumption is non proven. He believes that in the beginning the germs of all living species existed, but as conditions were unsuitable for the active development of all, some remained dormant until a suitable environment appeared. Having once appeared, a species might vary, within narrow limits, in accordance with slight environmental changes or might be entirely destroyed by more pronounced changes. G. M. F.

The Microscopy of Drinking Water.—By GEORGE CHANDLER WHIPPLE.
Revised by G. M. Fair and M. C. Whipple. 1927. Fourth Edition.
Rewritten and enlarged. xix, 586 pp., 19 plates and text-figs. Published
by John Wiley & Sons, Inc., New York, and Chapman & Hall, Ltd.,
London. Price 35s. net.

The complexity of the problems involved in the satisfaction of many of urbanised man's most fundamental needs, and the value of applied science in general, and of applied microscopy in particular, is well illustrated by the supply of pure water on a large scale. To the ordinary town-bred person it may seem the most natural thing in the world to turn on a tap and obtain as much good clean water as required. Of the many difficult problems, engineering, chemical and biological, that have had to be solved and still have constantly to be dealt with to guarantee such a supply, he probably has little, if any, idea. He may, however, rest assured that his needs could only have been so efficiently met as the result of long-continued labours of many scientific workers in many lands. Ample proof of this, so far as the biological side of the matter is concerned, will be found in the book now under review, which has deservedly reached a fourth edition. It is, in fact, one of the chief merits of this work that it brings together the results of many different lines of research in connection with all kinds of inland waters and their inhabitants, and shows their intimate bearing upon the highly technical question of water-supply.

Although it is impossible to refer to all the aspects of the application of microscopy to the examination and control of water for domestic purposes touched upon in this book, a brief summary of the contents may serve as an indication of the thoroughness with which the subject has been dealt. The two parts into which the book is divided are entitled "Applied" and "Determinative" microscopy respectively. The first two chapters are devoted to a preliminary account of the microscopic organisms occurring in fresh water from different sources, the purpose of their examination and their relation to the general question of the sanitary analysis of water. A very interesting matter, namely, the odours and tastes in water supplies, mostly due to either living or dead microscopic organisms, is next dealt with. It may be somewhat of a shock to many microscopists to learn that their pond-life favourites can give rise to unpleasant odours, even the beautiful *Volvox* being accused of producing a "fishy" odour. The next three chapters relate to the collection, examination, and recording of samples of water, and in this connection it is interesting to see the use made of the semi-logarithmic chart for the plotting of the record of microscopic organisms, a method proposed by the present writer in the *Journal of the Quekett Microscopical Club* in 1897. Then follow three very valuable chapters concerning Limnology considered from the physical, chemical, and biological standpoints,

while further chapters deal with the storage of water, Rheology (in this case confined to the microscopic life in flowing water), the self-purification of streams (a subject of very great importance), the control of algæ, the purification of water containing algæ, and finally, as regards Part I, the microscopic organisms in water conduits. Part II deals with the commoner microscopic organisms found in fresh water (except the bacteria which are excluded from the scope of the book), keys and descriptions, with figures on the plates, being given of the various genera. The ecological position of the species in accordance with Kolkwitz and Marsson's classification into polysaprobic, mesosaprobic, oligosaprobic and katarobic organisms forms the subject of the concluding chapter. A glossary of scientific terms and numerous references to the literature on each branch of the subject add considerably to the value of the book.

It is evident that to all those who have to deal professionally with water-supply Whipple's "Microscopy of Drinking Water" will be invaluable. It can also be cordially recommended to biologists generally, especially to those who desire to obtain some account of modern methods of limnological research and/or are particularly attracted towards the ecology of freshwater organisms. To those who are mainly concerned with the morphology and specific differences of the organisms the book does not pretend to appeal, but it will nevertheless be found very helpful by all who require a general introduction to the outstanding representatives of microscopic life in fresh water.

D. J. S.

Science of the Sea.—Edited by G. H. FOWLER and E. J. ALLEN. 1928. Second Edition. xxiii, 502 pp., 1 plate, 200 text-figs., 11 charts. Published by Humphrey Milford, Oxford University Press, 11, Warwick Square, London, E.C.4. Price 15s.

"Science of the Sea" is a work prepared by members of the "Challenger Society" (which is the English society founded for the promotion of the study of oceanography). The second edition is a handsome book, well printed and illustrated, and almost entirely rewritten. It is intended for travellers, sportsmen, explorers who may not be biologists, and other people who may be contemplating a long sea voyage or a lengthy stay by the seaside. It ought to appeal to the latter class of reader. There are many opportunities, on or by the sea, for fascinating and often most useful amateur studies, and it is well to have a good account of the methods by which such studies can be made: they need not involve an expensive equipment. Anyone, for instance, who has a microscope can, with this book and a few glass vessels, nets, etc., "enter a veritable wonderland" in the study of the marine plankton.

Experience has shown that the method and scope of the book before us are just what such people as are mentioned above require. The various chapters are written by naturalists and physicists who have specialised on the subjects about which they write. Each chapter treats generally and in a most interesting way on some part of oceanographical science. But the most valuable thing in the book is the practicality of it. Methods are fully dealt with, and, in particular, all that concerns collecting of marine animals and plants, preservation, storing, labelling, etc., is very well done indeed. There is an invaluable appendix giving the names of firms that supply apparatus. There is a good general guide to further literature. In short, all that the non-professional oceanographer requires is contained in the book. But even the general reader who does not intend to collect, and who only wants some book about the sea, will find this volume of extraordinary interest.

Oceanography in England has always been mainly marine biology, and its physical side has been subsidiary to a study of the conditions of life in the sea. Lately (and mainly in America) oceanography has been to some extent geological and geodetical in its outlook. It would be well to bear this in mind, even though this latter aspect of the science does not receive very much attention in the book before us. Oceanic soundings and the study of the shore, sea-bottom deposits, and the physics of the water may have important bearings on geological speculations. Oceanic soundings in particular are of immense interest from this point of view. There are enormous areas of ocean bottom that have not been adequately sounded, and some treatment of the general problems of geology and geodesy that require these data might convince the amateur oceanographer of the great utility of such investigation. J. J.

Eléments d'histologie.—By P. BOUIN. Vol. I. 1929. vii, 334 pp., 2 coloured plates, 200 text-figs. Published by Librairie Félix Alcan, 108, Boulevard Saint-Germain, Paris (VI^e).

Although the elements of histology have long been established, new facts and new interpretations of facts are constantly being brought to light as the result of new and improved histological technique, hence the need for new text-books of histology. Professor Bouin's "Eléments d'histologie," of which this is the first volume, although written primarily for medical students, reflects the experimental approach to the subject which has been so marked during recent years. Thus in the introductory chapter on the general cytology of the cell, the work of Chambers on micro-dissection is fully discussed. Incidentally, while Parat's views on the Golgi apparatus are stated, the work of Bowen and others on the relation of the Golgi apparatus to secretion receives no mention. The problems of cell division, of differentiation and cell specificity, are adequately dealt with, as are such questions as the nucleo-cytoplasmic ratio and cell movement. These chapters form the most interesting portion of the book, the remainder of which is taken up by a description, on more orthodox lines, of the connective tissues, muscles, bones, blood and blood-vessels. There is, of course, no index, and there are occasional misprints, e.g. Hoocke for Hooke, but the book is well produced, with many excellent illustrations. Each chapter is followed by a brief *résumé* and a bibliography which, though by no means exhaustive, serves as a useful guide for further reading. G. M. F.

PROCEEDINGS OF THE SOCIETY.

AN ORDINARY MEETING

OF THE SOCIETY WAS HELD AT 20 HANOVER SQUARE, W. 1, ON WEDNESDAY, DECEMBER 19TH, 1928, MR. JOSEPH E. BARNARD, F.R.S., PRESIDENT, IN THE CHAIR.

The Minutes of the preceding Meeting were read, confirmed, and signed by the President.

New Fellows.—The following candidates were balloted for and duly elected Ordinary Fellows of the Society :—

B. K. Johnson.
A. R. Nizam, B.Sc., F.Z.S.
Takeo Tamiya.
Thomas William Watts, H.D.D., L.D.S., R.C.S.

Signing the Roll.—On the invitation of the President, Mr. B. K. Johnson, being present at the Meeting, came forward and appended his signature to the Roll of Fellowship.

The Nomination Certificates of the following candidates were read for the first time and ordered to be suspended in the Rooms of the Society in the usual manner :—

As Ordinary Fellows—

Francis Arthur Bailey, Nairobi.
Charles William Dixon, Grimsby.
John Johnston, London.
James Stenson McDonald, Nairobi.
W. S. Warton, London.

As Honorary Fellow—

Dr. Ludwig Rhumbler, Münden.

Donations were reported from :

Mr. F. Carrel, F.R.M.S.—

“ Etude critique du transformisme.” (Carrel.)

Librairie Félix Alcan—

“ Eléments d’Histologie.” Vol. I. (Bouin.)

Votes of thanks were accorded to the donors.

The Death was reported of :—

Joseph Clark. Elected 1885.

A vote of condolence with the relatives was passed.

Nominations to New Council for election at the ensuing Annual General Meeting were read and approved.

The President read By-Laws 36-42, pertaining to the election of officers and members of Council.

The following papers were read and discussed :

Mr. E. Heron-Allen, F.R.S., F.R.M.S., and Mr. Arthur Earland, F.R.M.S.—

“ Some Further Notes on the *Pegididæ*.”

Professor E. Ghosh, M.Sc., M.D., F.Z.S., F.R.M.S.—

“ A New Parasitic Ciliate from the Intestine of the Bengal Monkey (*Macacus rhesus*),”

communicated by Dr. Tierney.

The following paper was read in title :

Mr. James Craigie, M.B., Ch.B.,—

“ The Demonstration of Bacterial Flagella.”

Votes of thanks were accorded to the authors of the foregoing communications.

The President made the following announcements :—

The Annual General Meeting of the Society will be held on 16th January, 1929, for the election of officers and members of Council for the ensuing year, and the delivery of the Presidential Address on “ Some Aspects of Ultra-Violet Microscopy.”

The Biological Section will meet in the Library on Wednesday, 2nd January, 1929, at 7.30 p.m.

The Rooms of the Society will be closed from December 22nd to December 29th, 1928.

The proceedings then terminated.

THE ANNUAL MEETING

OF THE SOCIETY WAS HELD AT 20 HANOVER SQUARE, W. 1, ON WEDNESDAY, JANUARY 16TH, 1929, MR. JOSEPH E. BARNARD, F.R.S., F.INST.P., PRESIDENT, IN THE CHAIR.

The Minutes of the preceding Meeting were read, confirmed, and signed by the President.

New Fellows.—The following candidates were balloted for and duly elected Ordinary Fellows of the Society :—

Francis Arthur Bailey.
Charles William Dixon.
John Johnston.
James Stenson McDonald.
W. S. Warton.

New Honorary Fellow :—

Dr. Ludwig Rhumbler, of Münden, was duly elected an Honorary Fellow of the Society.

The Nomination Certificates of the following candidates were read for the first time :—

Robert O. Ducker, Sheffield.
William D. Grier, New York.
Frank J. M. Robertson, Perth.

A Donation was reported from :

Oxford University Press—

“Science of the Sea.” 2nd Edition. Fowler & Allen.

A vote of thanks was accorded to the donors.

The Annual Report of the Council for the year 1928 was read as follows :—

FELLOWS.

Since the last Annual Meeting the Society has lost by death eight Ordinary Fellows, nine have resigned, and ten have been removed from the Roll under By-Law 31.

The Deaths reported are as follows :—

Charles S. Boyer. Elected 1914.
Thomas B. Bradshaw. Elected 1918.
Joseph Clark. Elected 1885.

William G. De Witt. Elected 1885.
 William Hartree. Elected 1867.
 Edmund Maurice. Elected 1921.
 George D. Neill. Elected 1924.
 Charles James Tabor. Elected 1911.

During the year thirty-eight Ordinary Fellows and one Honorary Fellow have been elected, and one has been reinstated.

JOURNAL.

Several important papers on technical and applied microscopy have been published in the Journal during the last year, together with extensive abstracts on microscopical subjects. The increased circulation continues to be maintained, and the list of subscribers has been still further added to.

The thanks of the Society are due to the Acting Editor, Dr. G. M. Findlay, and to the Editorial Committee and Panel of Abstractors for their services during the year.

A complete index to the articles on and references to the Diatomaceæ in the Transactions and Journals of the Society from 1853-1915 has been compiled by Miss A. M. Mainland, and published by the Society during the year. The thanks of the Society are due to Miss Mainland for her services in the compilation, and to Mr. Frederick Adams, who generously contributed £20 toward the cost of printing this index.

LIBRARY.

The Librarian reports that, as a result of the reorganisation, the usefulness of the Library has been considerably increased, and has resulted in a greater number of visitors thereto during the year, the number of volumes borrowed to December 31st being 164, and, in addition, one volume has been obtained from Lewis's Library for the use of a Fellow.

The new card index and catalogue of books in the Library has now been completed, and the latter is in the printers' hands and will be published early in the new year.

Donations to the Library have been received during the year from :—Librairie Félix Alcan, Messrs. Ernest Benn, Ltd., Trustees of the British Museum, Cambridge University Press, Mr. F. Carrel, Messrs. Chapman & Hall, Messrs. J. & A. Churchill, Messrs. Franz Deuticke, M. Paul Lechevalier, Messrs. E. Leitz (London), Messrs. Longmans, Green & Co., MM. Masson & Cie., M. Fernand Monpillard, National Physical Laboratory, Messrs. Oliver & Boyd, Sir Isaac Pitman & Sons, Ltd., Messrs. Putnam's Sons, Ltd., Messrs. George Routledge & Son, Ltd., and twenty-seven volumes and parts have been added by purchase. In addition, fifty-three volumes were bequeathed to the Society by the late Mr. Percy E. Radley.

Further progress has been made with the binding of Library sets of journals and periodicals, and the Rousselet collection of papers, thirty-three volumes in all, on the Rotifers, etc., have been bound and catalogued and are now available for reference.

With a view to extending the scope and usefulness of the Library, the Committee would welcome suggestions from Fellows for recommendation to Council for the purchase of any books of reference on microscopical subjects not already in the Library.

The Council announces with regret the resignation of Mr. S. C. Akehurst from

the office of Hon. Librarian, and desires to place on record its appreciation of his services to the Society. The thanks of the Fellows are also due to the Library Committee for their unremitting services during the year in the reorganisation of the Library and preparation of the card index and catalogue.

INSTRUMENTS AND APPARATUS.

The Curator of Instruments reports the following accessions to the Society's collection during the year :—

1. Watson Edinburgh "H" microscope and accessories in case (reconditioned through the kindness of Messrs. W. Watson & Sons).

2. Swift Stevenson binocular dissecting microscope and accessories in case.

The above were bequeathed to the Society by the late Mr. Percy E. Radley.

3. A Benjamin Martin microscope and accessories in case, presented by Mr. C. D. Soar.

4. An early English portable microscope and accessories in case (c. 1780), presented by Mr. G. T. Harris.

During the year a volume entitled "Origin and Development of the Microscope" has been published by the Society under the editorship of A. N. Disney, C. F. Hill, and W. E. Watson Baker, containing an illustrated account of the Society's historical collection of microscopes and accessories, with an introductory survey of the early history of optics up to and including the advent of the microscope. It is hoped that during the present year it will be possible to rearrange the Society's collection of instruments to correspond with the order in which these are described in the volume referred to, so that those interested will be able readily to recognise and examine the different models.

SLIDE CABINET.

The Curator of Slides reports that twelve slides have been borrowed from the cabinet during the year, and that six hundred slides have been added to the Society's collection from the Radley bequest. The thanks of the Society are due to Mr. Arthur Earland for examining and remounting one hundred and twenty-one foraminifera slides from this bequest.

MEETINGS.

The Council has held ten meetings, and nine Ordinary Meetings of the Society have been held during the year. The number of exhibits and demonstrations of instruments and apparatus at the Ordinary Meetings has increased, and the attendance has been well maintained.

The Annual Pond Life and General Microscopical Exhibition was held as hitherto in June, and, in order to meet the wishes of several of the Fellows, it is proposed that this exhibition should in future be held in October.

The Secretary of the Biological Section reports that the Section continues to maintain its interest and support amongst the Fellows, and the attendances at its meetings have been good. The Session has been characterised by the large number of interesting subjects dealt with in short notes. Full report is unnecessary.

The thanks of the Society are due to the following firms :—Messrs. R. & J. Beck, Ltd., The Laboratory Equipment Co., Messrs. E. Leitz, and Messrs. W. Watson & Sons, Ltd., who have kindly loaned instruments and apparatus for the use of the Society at its meetings and demonstrations during the year.

* Mr. C. Beck moved and Mr. D. J. Scourfield seconded: "That the Annual Report be received and adopted." Carried.

Canon G. R. Bullock-Webster moved and Mr. A. Earland seconded: "That a very hearty vote of thanks be tendered to the officers and members of the Council for their services during the past year."

Carried unanimously.

Professor R. Ruggles Gates responded.

THE ELECTION OF OFFICERS AND MEMBERS OF COUNCIL.

The President appointed Mr. J. Richardson and Mr. J. Wilson to act as scrutineers, and afterwards declared the result of the ballot for the election of officers and members of the Council for the ensuing year as follows:—

President.—Joseph E. Barnard, F.Inst.P., F.R.S.

Vice-Presidents.—R. S. Clay, B.A., D.Sc., F.Inst.P.; James A. Murray, M.D., F.R.S.; A. S. Parkes, M.A., D.Sc., Ph.D.; E. A. Robins.

Treasurer.—Cyril F. Hill, M.Inst.M.M., A.Inst.P.

Secretaries.—R. Ruggles Gates, M.A., Ph.D., F.L.S.; Clarence Tierney, D.Sc., F.L.S.

Ordinary Members of Council.—W. E. Watson Baker, A.Inst.P.; J. G. Bradbury; F. W. Rogers Brambell, B.A., D.Sc., Ph.D.; J. D. Coales, D.Sc.; A. N. Disney, M.A., B.Sc.; A. Earland; G. M. Findlay, O.B.E., M.D., D.Sc.; J. E. McCartney, M.D., Ch.B., D.Sc.; J. H. Pledge; J. Rheinberg; G. S. Sansom, D.Sc.; E. J. Sheppard.

Librarian.—Clarence Tierney, D.Sc., F.L.S.

Curator of Instruments.—W. E. Watson Baker, A.Inst.P.

Curator of Slides.—E. J. Sheppard.

On the motion of the President, a vote of thanks was accorded to the scrutineers.

Mr. JOSEPH E. BARNARD then delivered the Presidential Address:

"Some Aspects of Ultra-Violet Microscopy."

Mr. J. Rheinberg moved: "That the best thanks of this meeting be accorded to Mr. Joseph E. Barnard for his Presidential Address, and that he be asked to allow it to be printed in the Journal of the Society."

Mr. E. A. Robins seconded the proposal, which was carried by acclamation.

Mr. Barnard responded.

The President announced that the Biological Section would meet in the Library on Wednesday, February 6th, at 7.30 p.m.

The business proceedings then terminated.

AN ORDINARY MEETING

OF THE SOCIETY WAS HELD AT 20 HANOVER SQUARE, W.1, ON WEDNESDAY, FEBRUARY 20TH, 1929, DR. JAMES A. MURRAY, F.R.S., VICE-PRESIDENT, IN THE CHAIR.

The Minutes of the preceding Meeting were read, confirmed, and signed by the Chairman.

New Fellows.—The following candidates were balloted for and duly elected Ordinary Fellows of the Society :—

Robert O. Ducker.
William D. Grier.
Frank J. M. Robertson.

The Nomination Certificate in favour of the following candidate was read for the first time :—

Charles Wilson Peck, London.

Donations were reported from :

McGraw-Hill Publishing Co.—

“ Laboratory Manual of General Microbiology.” (Fred and Waksman.)

Chapman & Hall—

“ Practical Bacteriology.” (F. W. Tanner.)

Humphrey Milford—

“ Handbook of Microscopical Technique.” (C. E. McClung.)

Baillière, Tindall & Cox—

“ Manual of Helminthology.” (H. A. Baylis.)

Votes of thanks were accorded to the donors.

The Deaths were reported of :—

F. R. Dixon-Nuttall. Elected 1892.

Marshall D. Ewell. Elected 1886. Honorary Fellow, 1925.

Votes of condolence with the relatives were passed.

The following papers were read and discussed :—

Dr. R. G. Canti and Dr. F. G. Spear—

“ Some Effects of Radium on Cell Division *in vitro*.”

Miss S. F. Cox—

“ Some Effects of X-Rays on Cell Division *in vitro*.”

Dr. F. G. Spear—

“ An Effect of Low Temperature on Cell Division *in vitro*.”

Demonstrations :—

Miss S. F. Cox—

“ The Effect of a Heavy Dose of X-Rays on Living Cells as shown by the Dark-Ground Method.”

Dr. R. G. Canti—

“ Demonstration of Cell Division in the Living Tissues cultivated *in vitro*.”

(Apparatus provided by the Strangeways Research Laboratory.)

Series of stained preparations showing :—

(a) The Effect of Radium on Cell Division.—Dr. R. G. Canti.

(b) The Effect of X-Rays on Cell Division.—Miss S. F. Cox.

(c) The Effect of Low Temperature on Cell Division.—Dr. F. G. Spear.

Votes of thanks were accorded to the authors of the foregoing communications and to the Strangeways Research Laboratory for the loan of apparatus for the demonstrations.

A vote of thanks was also accorded to Messrs. E. Leitz for the loan of microscopes for the meeting.

The Chairman announced that the Biological Section would meet in the Library on Wednesday, 6th March, 1929, at 7.30 p.m.

The business proceedings then terminated.

JOURNAL
OF THE
ROYAL MICROSCOPICAL SOCIETY.

JUNE, 1929.

TRANSACTIONS OF THE SOCIETY.

PRESIDENTIAL ADDRESS.

V.—SOME ASPECTS OF ULTRA-VIOLET MICROSCOPY.

By J. E. BARNARD, F.R.S.

(Delivered January 16, 1929.)

THREE PLATES AND FIVE TEXT-FIGURES.

THE subject that I have selected for this, my third Presidential address, is one to which I have devoted a good deal of my available time during the last few years. I did, on one occasion, bring to the notice of the Society some of the results obtained, but I have never yet described in detail the apparatus that I have designed, and in large part constructed, for the production of ultra-violet photo-micrographs. For this failure to describe adequately the methods evolved I have been condemned in no uncertain terms by many, and by some few whose opinion I value. The result has been, I admit, in some respects unfortunate, as it has given an opportunity for descriptions to be launched that are not, perhaps, strictly accurate, and descriptions which would certainly not have been launched had the material that I have at my disposal been available. This, however, will have little effect ultimately on a research that will not be fully justified, much less completed, for some time to come.

A Presidential address is no opportunity for repairing omissions, and I

have no intention of making the attempt. It is rather an occasion for a general survey of a subject, enlivened, it may be, with some speculative, if impracticable, ideas as to future developments. Many suggestions have reached me for carrying out most, if not all, of my technique in some better way ; but, perhaps because I am now too old to be sufficiently receptive, I have continued along lines that appear to me to have some promise of success. In the hope that I may be able to interest some of those present this evening, I shall only deal with those parts of my subject that have general interest, leaving the technical side for a more general survey which I hope to publish in the Journal of this Society.

There are a good many practical points that are not generally appreciated, the salient one of which, perhaps, is that in ultra-violet work of any sort we are confined to the use of certain natural products—that is, artificial materials such as manufactured glasses, which are generally used in visual microscopical work, are as yet of no real service. We have, therefore, to fall back on substances that occur in Nature, and those are very limited in number. I have on show here to-night just a few samples of the materials that are available, the first of which in importance is quartz. Quartz occurs naturally in the crystalline state, but it is variable, as all natural materials are, and it is doubly refracting. There are two fine specimens of quartz on the table, one of which is clear and colourless, while the other one shows a certain smokiness in mass due to some impurity, probably iron. The result is that if you break it up or look at thin slices, you will, on cursory examination, see no difference between a good specimen and a specimen that is not so good. If you test it for transparency to ultra-violet light, you find the smoky material is less transparent, and it would not do at all for some purposes. In recent years quartz has been fused in sufficiently large pieces to be of use for making small lenses. It is, however, difficult to produce it in homogeneous pieces of any size, and this difficulty is a very real one in the production of microscope objectives for use in the ultra-violet region, where the correction has to be of a high order—how high it is not yet possible to define with accuracy—although it is probable that both in design and construction the necessary precision is at least doubled.

Another remarkable material is fluorite, which, as you know, is used to form one of the components of an apochromatic objective. For the latter purpose it is not so important that the fluorite should be free from fluorescence, but with ultra-violet light work the question of fluorescence becomes a really important one. I have two specimens on the table here which we will illuminate by means of a beam of ultra-violet light. You will notice that one specimen fluoresces brightly enough for all to see, whereas the other specimen is quite free from fluorescence. To an observer in visual light both are fine specimens, but the one that fluoresces would be useless for any part of an ultra-violet microscope ; it would convert too much energy into visible light. The slide on which the object is mounted for ultra-violet microscopy is made from crystalline quartz, and the cover-glass is usually

of fused quartz. Therefore the difficulty of getting suitable material is greater in the case of the cover-glass than of the slide. Fused quartz is used because its property of double refraction is largely, and in some few cases entirely, eliminated, but there are other faults that can become only too apparent.

Figs. 1 and 2 are photographs of two such cover-glasses taken by projecting a beam through them horizontally—that is, in the plane of the paper if lying on the table. One cover-glass is free from faults, but the other one is full of small flaws. To the ordinary eye, if observed without any means of increasing the apparent size of these defects, little difference

FIG. 1.

FIG. 2.

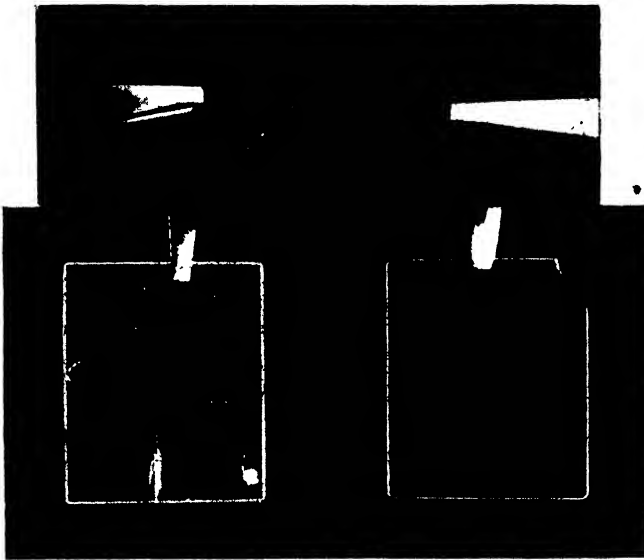


FIG. 3.

FIG. 4.

is to be seen, but for photographic work in the ultra-violet one specimen would be satisfactory, the other useless.

Figs. 3 and 4 show slides made from fused quartz which have the same type of defect, but the imperfections are accentuated owing to greater thickness. Objectives are still being made from fused quartz; it is therefore of the first importance to ensure that the material is free from defects of any sort. It is only fair to Messrs. Zeiss to say that when they made their first apparatus, over twenty years ago, they were apparently in a strong position in this respect; they were even at that time able to produce fused quartz of high quality.

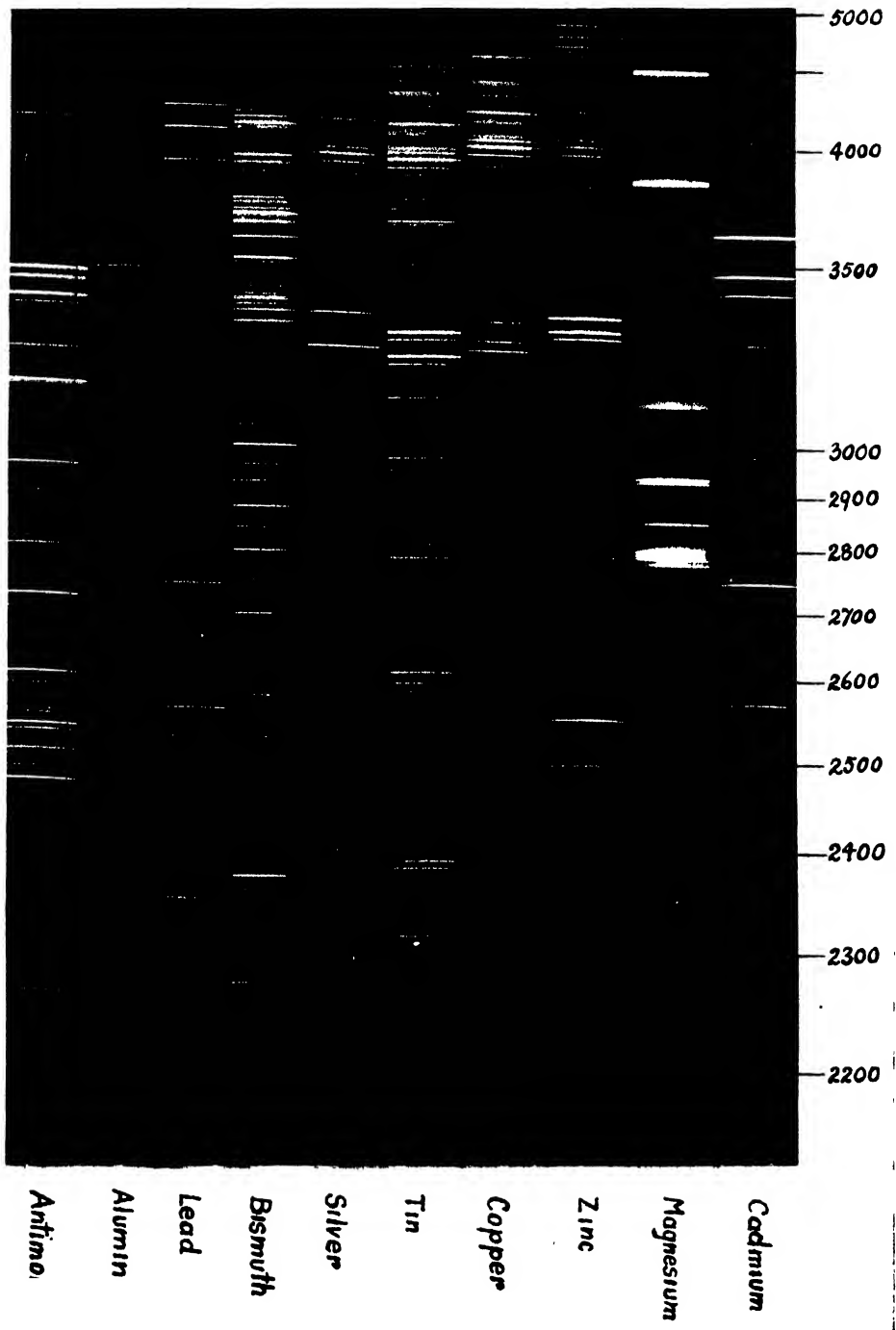
At the present time perhaps the most formidable difficulty in the production of a quartz objective is to obtain material of the necessary quality. When this is available, such objectives can be made in this country—as

Messrs. R. & J. Beck, Ltd., have shown—which are unsurpassed elsewhere. Among other substances familiar to us as microscopists are calcite and selenite, both of which possess considerable transparency to ultra-violet, but neither are as yet of value in ultra-violet microscopy except for experimental purposes. It is of interest to note that this Society has in its collection a very large and apparently fine block of crystalline calcite, as well as a specimen of selenite of unusual optical quality, both of which are on view at this meeting.

Let us for a few moments consider the question of illuminants suitable for ultra-violet work, as there is a considerable departure from ordinary practice in this essential. It is important to remember that the objectives made hitherto are corrected for light of one wave-length only. It is quite different from the position to which we are accustomed with visual light, where our objectives are corrected for the whole range of the visual spectrum. The reason for this difference will already have become evident to some of my audience. It is an unavoidable result of using one material only for the construction of objectives. Where correction of any sort has to be obtained by variation in curvature of component lenses or by separation, the possibility of combining lenses of suitable optical qualities made from different materials does not exist.

It follows, therefore, that the source of light must be in a practical sense of one wave-length. In the present state of knowledge such an illuminant can only be produced by means of a high-tension electric discharge taking place between electrodes of suitable pure metals. By this method the energy output is confined to single bright lines or small groups of lines separated by dark spaces. It is of some interest to see what that means, as there are few metals that give a suitable spectrum for such work (plate I).

A few spectra are shown to illustrate the most suitable type. Cadmium is the best, as it has bright lines at 227, 257 and $275\mu\mu$, each being separated by dark spaces or by spaces containing faint lines. It is not only necessary to have bright lines of the utmost obtainable intensity, but these must be separated sufficiently to ensure that the image of the spark in one wave-length can be projected into the field of view of the microscope without any overlapping images. It will be appreciated that the method of illumination is to split up the spark image by means of quartz prisms and to project the spectral images so obtained on to the back lens of the sub-stage condenser. The cadmium spark image in wave-length $275\mu\mu$ is still the most suitable for the purpose, and is the one used by Kohler in the original design of apparatus as made by Zeiss. In magnesium at $283\mu\mu$ a very bright group of lines occurs, which can be used for some purposes, but the results are not so good, although the necessary exposure is substantially reduced. The remaining spectra show the distribution of light energy with the intervening dark spaces. Some of them are of use, but others, owing to the large numbers of lines and their uneven distribution throughout the spectrum, are at present of little value. It is necessary to remember that



the apparent reduction in intensity of the shorter wave-lengths is largely due to want of sensitiveness of the ordinary photographic plate to that region.

One of the reasons for the use of ultra-violet light in biological work is that no staining is necessary; it would, in fact, defeat the very purpose of the method. The full advantage of this will not become apparent until objectives are available which can be used over a range of wave-lengths; even if this range is short, the gain will be great. The difference of absorption by organic materials even over a range of a few Angstrom units is evident in recent published work, and makes an appreciable difference in the result. It is very difficult, if not impossible, to use screens in the sense that we use colour screens for visual light. There are not many screens that are sufficiently definite in transmission and absorption for use in the ultra-violet; the loss of energy is considerable, and there is the possibility of rapid change in the



FIG. 5.

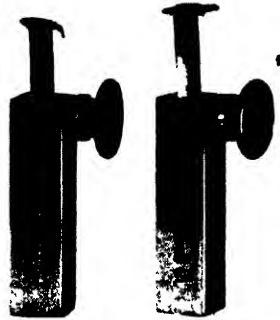


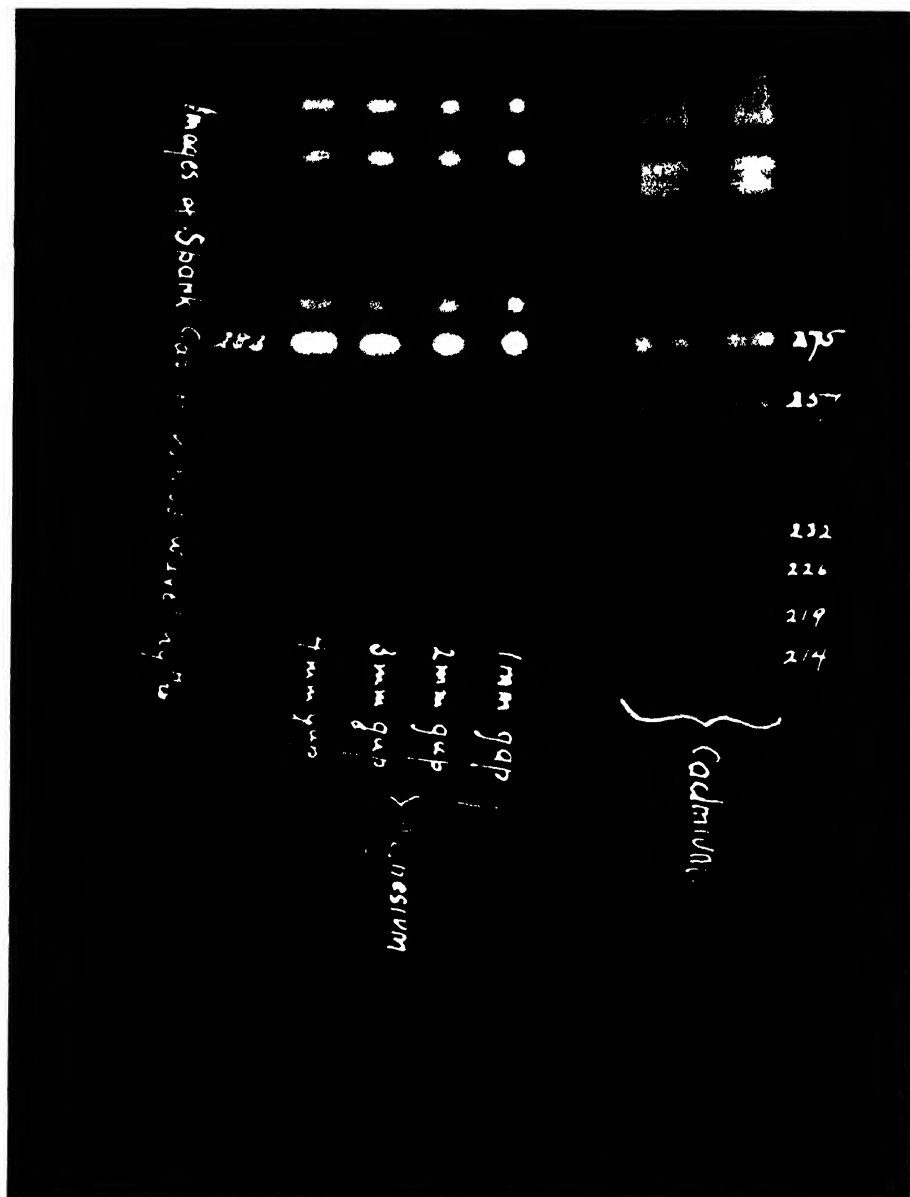
FIG. 6.

screen itself, as strictly selective absorption is not obtained easily by using solutions of inorganic salts.

There is one rather important point about spark illumination that will appeal to all microscopists, and that is the actual nature of the spark image. In visual work we like a circular illuminant of uniform luminosity, so that the image of the radiant may be projected, if desired, into the field of view, but this state of affairs is not secured so easily with a spark. The difficulty is increased when various metals are used, as the necessary current, density and length of spark vary with the properties of the metals used. Thus cadmium and magnesium, which are the two most useful metals, have quite different standards of behaviour. Figs. 5 and 6 illustrate one of these differences, and show that while magnesium burns away steadily, maintaining a fairly constant end form, cadmium, presumably owing to its being more ductile, spreads out into a mushroom-like excrescence. The result is that with cadmium a spark is obtained with two intense areas, one at the end of each electrode; it is, in fact, a pole effect with an intervening gap of less

intensity. If spark length is reduced too much, the intensity falls off and other electrical troubles appear; but under suitable conditions, which can only be determined experimentally for each metal, a round, uniform and intense light source is produced. From a microscopical point of view it is almost ideal. Plate III shows the difference sufficiently clearly to need no further explanation. This variability in the light source has given us much trouble; no definite rule can be laid down except by determining experimentally the necessary current and spark length for each metal used. We should like to get a very much more intense source of light, so that our exposures could be reduced by at least one-twentieth, but there seems little immediate probability of this being achieved. All our efforts in the direction of increasing current density, or the potential difference between the electrodes, have not yet proved sufficiently useful to warrant any drastic change of method. It seems that one can, as with the ordinary carbon arc, increase the electrical current density without any substantial increase in intrinsic brilliance. It is possible to increase the size of the illuminant, but the intrinsic brilliancy on the whole alters but little, so we are devoting attention to other methods of reducing exposure, and one at least of these I shall refer to directly. It will be appreciated that the spark images are the actual illuminants, not bright lines as shown in spectrograms (plate I) taken with a slit spectrograph. The images so obtained and photographed by means of a pinhole camera are seen in plate II, and the result of varying the distance between the electrodes is shown. This again is a practical difficulty, as the spark differs in character with the metal used, and also alters in form as the spark lengthens. This has made it necessary to introduce into the ultra-violet apparatus an arrangement for observing the spark with sufficient accuracy to appreciate small differences in the spark gap. A pinhole camera is used for observation purposes, and is sufficiently accurate to enable a spark image of almost constant length and form to be secured if adjustment is made at short intervals of time.

I have referred to the transmission of ultra-violet light by certain transparent substances, but have not said anything about materials that are good reflectors. In view of the importance of dark-ground illumination in visual work, and the substantial advances that have recently been made, it is to be expected that work would be attempted on the same lines with ultra-violet light. So far as I know, my own work in that direction still stands alone, yet it represents the most important advance in microscopical method of recent times. As you know, a modern dark-ground illuminator is essentially a reflecting system relying on spherical silvered surfaces for its production of an annular beam of light by reflection from such surfaces. It might at first glance appear possible to use such an illuminator for ultra-violet work, but by an unhappy chance silvered surfaces are quite unsuitable. In fact, one can go further and say they are the least suitable for such work of all known reflecting surfaces. A silvered quartz plate does, in fact, make quite a satisfactory screen which will reflect a large percentage of visual light while



transmitting a substantial portion of ultra-violet. A silvered surface, therefore, is of no value, and we must look for some other metal which will take a high polish and that has a high reflecting value for light of short wavelength. Much work in this direction has been done in my own laboratory, with the result that we now have samples of magnalium, the most suitable metal for the purpose, which does in certain wave-lengths reflect as much as 81 p.c. of the incident light. A short table has been compiled from various sources and is reproduced here (fig. 7). to indicate the large variation that occurs in reflecting power, and it also shows that certain metals, such as nickel, which reflects well in the visible, are not so suitable for our purpose. It is well to point out that all these reflecting values are dependent on the production of a polished surface of high quality, a by no means easy thing to

Wavelength. $\mu\mu$.	Steel.	Cobalt.	Silver.	Nickel.	Platinum.	Woods' Alloy.
226.5	34.8	---	18.4	---	---	---
231.3	35.7	31.8	19.9	---	---	---
257.3	39.6	39.7	24.1	30.7	37.1	52.7
274.9	---	---	---	37.6	43.9	56.6
298.1	42.6	45.7	15.4	39.4	47.6	61.1
316.0	---	---	4.2	---	---	---
325.5	44.8	---	8.5	40.4	48.9	64.9
346.7	---	51.1	68.0	---	---	---
361.1	51.2	---	77.4	41.2	52.4	65.2
395.0	53.5	57.7	87.1	---	---	---
398.2	---	---	---	50.6	57.5	68.8

Magnalium. 283 $\mu\mu$ 81% (Smiles)
Reflection-factors of Metals (in per cent)

FIG. 7.

secure. The difficulty is, however, now being overcome. My colleague Smiles is now able to polish magnalium satisfactorily, and Messrs. R. & J. Beck have produced an ultra-violet dark-ground illuminator of fine quality. The first one made by them was of similar design to their high-power illuminator, which is of outstanding merit for visual work. The reflecting surfaces are of magnalium, and the top lens, the one that is in immersion contact with the under-side of the slide, is of fused quartz. Homogeneous immersion is then secured by a water glycerine mixture similar to that used with a quartz immersion objective. A quartz objective of about 1.0 N.A. in terms of visual light can be used, and the results obtained are, in my opinion, a striking advance, at least with biological material, on anything hitherto used. One disadvantage we are faced with is that the necessary exposure to obtain a satisfactory photograph is still rather too long for many objects, a disadvantage that also occurs very generally even with visual light, unless

a light source of high power is used. In ordinary work an electric arc can sometimes be used, but with ultra-violet light the spark source, with all its limitations, is the only one available. We are experimenting in several ways to overcome this difficulty with the object of ultimately obtaining instantaneous photographs. If we succeed in reducing the necessary exposure to one-tenth of a second, it will be possible to attack many biological problems, particularly those in connection with the study of the filterable viruses, in which my interest is greatest.

One effort at present in progress I will describe briefly, as it has some element of novelty. It is hardly necessary for me to say that all dark-ground methods are founded on illumination by means of an annular beam, and that this involves considerable loss of light, as only a portion of the image of the radiant is brought into use. The arrangement now under trial

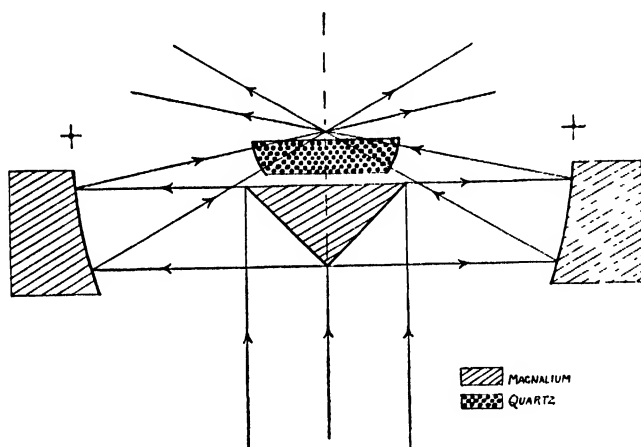
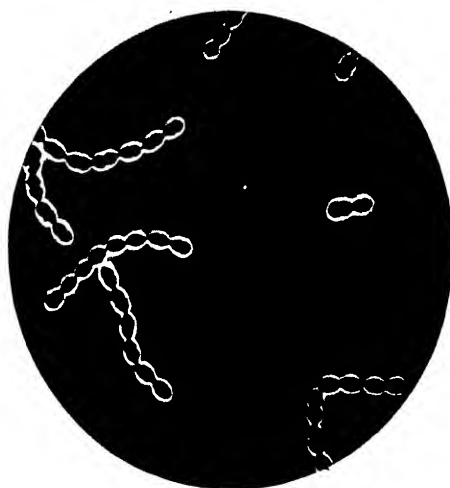


FIG. 8.

is shown in principle in fig. 8. Instead of an annular opening, the full beam is received by a magnalium cone which reflects the whole of the light from the radiant on to the internal reflecting surfaces, and from this passes through the fused quartz front and is concentrated at the position on the slide occupied by the object. The diagram is sufficiently clear for anyone conversant with such appliances to appreciate the arrangement. A further improvement on this provisional form has been evolved in my laboratory, and Messrs. Beck are now making an illuminator which, from the experimental evidence we already possess, appears likely to be of considerable value. As I have already said, this is not the only factor we are considering, but from its very nature it must be the most important one, and will be of great value should it realise our expectations.

Even at the risk of telling you an old story, might I draw your attention to the increase of resolution expected as the result of using ultra-violet light. It is embodied in fig. 9, and shows the resolution we should get on



theoretical grounds. The N.A. is given in terms of visual light : it takes no account of the increase that occurs as the result of using shorter wave-lengths. On the left is a wave-length scale in Angstrom units. The next vertical column sets out certain bright lines in the spectra of cadmium, magnesium, zinc and aluminium. Below that the limits of transmission are indicated, and we see that quartz and air are broadly of the same transparency—in fact, the limit in dry air comes very close to that of crystalline quartz. Fluorite, however, is much more transparent than air, and selected pieces will transmit down to nearly 1,200 Angstroms, a most remarkable

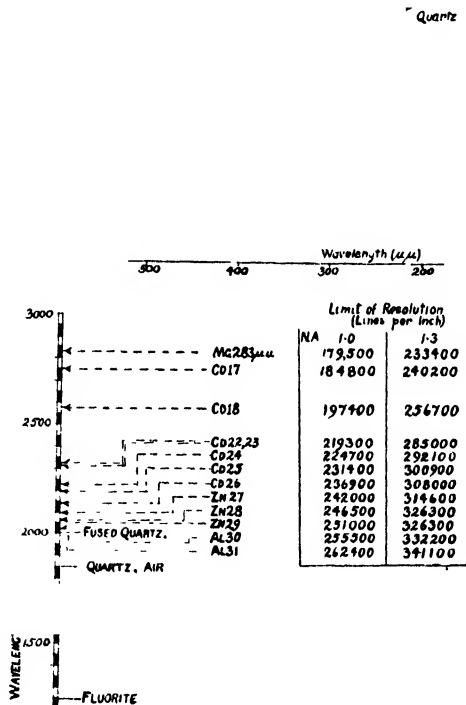


FIG. 9.

physical fact for which there are few parallels in nature. As fluorite has been used in the manufacture of objectives for many years, it is of interest to know something about it, and it is only the limitations of time that prevent me from saying more.

The resolving power is set out opposite to each wave-length, and needs no further explanation, but it does reach a very high figure at or near to the limit of transmission for fused quartz. This substance is used in the construction of ultra-violet objectives, and at least for the present it limits the path of progress. The relative refractive indices of quartz, fluorite, and water are also shown in the upper part of this diagram, and it is of interest

to see that water alters most in shorter wave-lengths. In the design and construction of lenses in the future it is possible that this property may be of value, as the difference between quartz and fluorite is not great enough for correction to be secured easily. Attempts at new computations are, however, now being made both by the Department of Scientific and Industrial Research and in my own laboratory. It remains to be seen what the results will be, but I see no reason to be pessimistic—rather do I think that there is much ground for optimism. Whatever may be the outcome of this work, it is worth doing, and much is being learnt during its progress. In general terms it is essential that we should be able to secure visibility of microscopical objects before other optical factors are fully worked out. I have little doubt that such visibility will not satisfactorily be obtained by any staining method, so far at least as the observation of the smallest living things is concerned; it is more likely that observation of living material will lead to a solution.

I can hardly conclude this rather scrappy address without reference to the application of some of these physical methods to biological research—particularly to those problems in which my interest is greatest—connected with the smallest living things. However interesting it may be to improve microscopical method and instrumental resources, it does appear to me that such things can only be justified when they extend our knowledge in some direction. It may be said with truth that the physical side of microscopy is by far the easier; it is when attempts are made to apply any new method that the difficulties really begin. For that reason I think it is justifiable to conclude that such work can only be carried to a successful issue when improvements in apparatus are carried out at least in close collaboration with those who are attacking definite problems that await a solution. In my own case it would afford me the greatest satisfaction if I should be able to contribute to the knowledge already accumulated on such a subject as the filterable viruses. Micro-organisms of many varieties have now been photographed in my laboratory by means of this new method of dark-ground ultra-violet microscopy, and I venture to express the opinion that by no other method can comparable results be obtained. I am selecting three photographs only from those I am showing this evening, as I am afraid that the inevitable loss that will occur as the result of reproduction will detract from their value. In some of these photographs the wealth of fine detail cannot possibly be seen except in the original negatives, and it is just this fine structure and its satisfactory delineation that constitute the value of the results. Many of the details seen are of as small an order of size as some viruses must be, that is if we accept the theory that they are particulate and behave in some ways at least as larger micro-organisms do. That we have been successful in obtaining photographs of organisms to which the term “virus” is applicable, I think is probably true, but there is so much to do to confirm this to the satisfaction of other interested workers that I hesitate to refer to it further at this stage. Still, the work proceeds, slowly,

it is true, but unless it did hold out some hope, the feeling of discouragement and disappointment would be strong enough to annihilate the chance of progress. I can, in conclusion, only express the wish that I may be able at no distant date to communicate to this Society some results that are of value and that have been arrived at by the methods I have from time to time described. If I should be so able, I am sure that I shall receive that sympathetic hearing and that tolerance for shortcomings that the Fellows of this Society have so consistently extended to me in the past.

DESCRIPTION OF PLATES.

PLATE I.—Spark spectra of metals. These show that the spectra of certain metals, such as cadmium, magnesium, zinc, silver, lead and aluminium, are suitable for use in ultra-violet microscopy, as their lines are separated sufficiently. Others, such as bismuth and tin, are unsuitable, because the lines are too numerous and not separated sufficiently.

PLATE II.—Spark images in magnesium and cadmium, showing the effect of differing spark gaps.

PLATE III.—Photo-micrographs of bacteria taken by ultra-violet dark-ground illumination.

- (a) *Bacillus megatherium*. $\times 3000$.
- (b) *Bacillus mycoides*. $\times 3000$.
- (c) *Streptococcus pyogenes*. $\times 3000$.

VI.—SOME NEW FORAMINIFERA FROM THE SOUTH ATLANTIC.

I.

By E. HERON-ALLEN, F.R.S., F.R.M.S., and ARTHUR EARLAND, F.R.M.S.

(Read May 15, 1929.)

THREE PLATES.

SINCE November, 1925, the R.R.S. *Discovery* and the R.S.S. *William Scoresby* have been engaged in scientific observations in the South Atlantic, principally in the vicinity of the Falkland Islands, South Georgia, and the South Shetlands. We have been entrusted with the examination of the bottom deposits obtained, for the purpose of determining the foraminifera, and, pending the completion of a full report, by the courtesy of Dr. Stanley Kemp, the Director, and the *Discovery* Committee, we are permitted to describe some of the new and interesting forms which have been observed.

* * * * *

Order—Foraminifera.

Family—Astrorhizidæ.

Sub-Family—Saccammininæ.

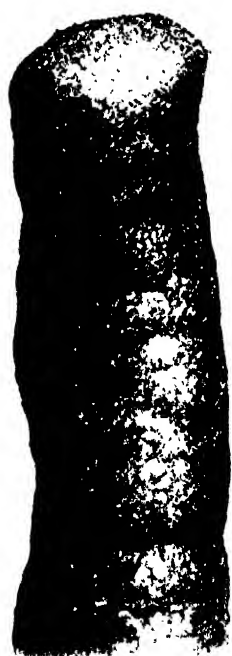
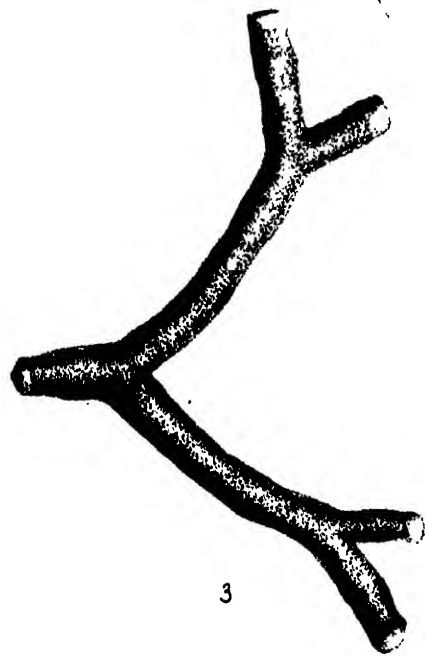
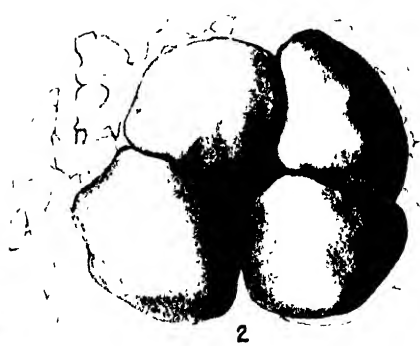
Genus—*Sorosphæra*. H. B. Brady, 1879.

SOROSPHERA DEPRESSA sp. nov.

Plate I, figs. 1-2.

Test attached, light to dark grey in colour according to the constituent particles, consisting of a variable number of irregularly-shaped chambers spreading without definite plan over a stone or other surface of attachment, and often following a crack or superficial depression for protection. The walls are thin, firmly and smoothly constructed of fine sand grains and cement, but they are dull and unpolished. The outer surface is rougher than the interior wall of the chambers, which have a chitinous lining.

Each chamber forms a distinct and separate entity enclosed within its own walls and base. There is no sign of any aperture or means of communication between the chambers. Communication with the external medium can be only through minute interstitial openings in the wall of the test. The openings shown in fig. 1 are only incidental fractures of the wall.



When a colony is attached to a stone, as in pl. I, fig. 1, the test forms quite a solid object capable of sustaining considerable stress, but when growing on a flexible base, the chambers are readily separable without fracture of the walls of the test. See pl. II, fig. 2.

Monothalamous Arenacea, when sessile, are usually more or less semi-globular in plan, but in *Sorosphaera depressa* the chambers are distinctly polygonal. This in some cases is due to the irregularities of the surface of attachment, but specimens have been observed (see pl. II, fig. 2) which suggest that the organisms first form a quadrate colony, and thereafter spread irregularly in the line of greatest protection or least resistance.

Dimensions of chambers vary considerably from 0.3 mm. to 0.8 mm. in diameter. A colony may cover a space of 0.5 square centimetre. The thickness of the wall is only about 0.02 mm.

Locality.—The species has so far been observed in two gatherings only from the Antarctic, viz., *Discovery* Station 182, Schollaert Channel, Palmer Archipelago (64° 21' 30" S., 68° W.) 160–335 metres, mud; and *William Scoresby* Station 113, off Cumberland Bay, South Georgia (54° 07' S., 36° 24' W.), 155 metres, grey mud and stones. Very little Antarctic material has so far been examined, and the distribution may yet prove to be extensive.

SUB-FAMILY—RHABDAMMINÆ.

SCHIZAMMINA gen. nov.

Test free, arenaceous, a rounded unseptate tube, dichotomously branching, approximately in one plane. The wall of the tube is labyrinthic in structure, consisting of fine sand grains firmly cemented together, spicules or other foreign material being rarely used. Colour yellow to brown, according to the amount of ferruginous cement used in the outer layer, which is dull and unpolished, becoming grey at the extremities of the branches, which are sometimes open and at other times closed with a cap of loosely agglutinated sand grains. The extremities, whether open or closed, serve as apertures for the protrusion of the protoplasm. The labyrinthic wall is perforated in all directions by ramifying canals which originate in large oscules, covering the surface of the inner tube. The canals sometimes expand into vacuoles or chamberlets in the thickness of the wall, but do not penetrate the external wall of the test.

Schizammina in its general appearance, its dichotomous method of growth, and its unseptate central tube, is obviously nearly allied to the genus *Rhabdammina* M. Sars. But it differs entirely from that genus in its labyrinthic wall, a feature which brings it into association with *Botellina* Carpenter. *Botellina*, however, has a well-marked bulbous initial chamber, and no definite tubular body cavity, the whole central space being filled with labyrinthic outgrowths from the wall. *Schizammina* may therefore be regarded as occupying a position intermediate between *Rhabdammina*

and *Botellina*, and its discovery may serve as additional proof of the soundness of Brady's judgment when he included *Botellina* in his sub-family *Rhabdammininæ*, although superficially the genus had little in common with *Rhabdammina*. It is possible that the abnormal form figured and described by Pearcey under the name *Botellina pinnata* * is more nearly allied to *Schizammmina* than to *Botellina*. True, it resembles that genus in the possession of a bulbous primordial chamber, but the central cavity is well defined, and the inner wall of the labyrinthine structure has large oscules not unlike those of *Schizammmina*, though on a coarser scale.

The nearest relative of *Schizammmina* is probably *Rhabdammina irregularis* † Carpenter, a somewhat localised species with which we are familiar in deep-water dredgings from the West of Ireland. This almost alone among the *Rhabdamminæ* has a dichotomous method of growth, and we were so much struck with its external resemblance to our species *S. furcata* that we made sections, with the expectation that *R. irregularis* would prove to be a *Schizammmina*. We found, however, that it was entirely devoid of labyrinthine structure and in all respects a true *Rhabdammina*.

Schizammmina has so far been found, in company with other Astrorhizidæ, only in the material trawled at *Discovery* Station 279, off Cape Lopez, French Congo, in 58–67 metres, on a bottom of mud and fine sand. It is worth recording that the bottom temperature was 14.94° Cent. The Astrorhizidæ are normally inhabitants of deep water, or high latitudes where shallow water temperatures approximate those found in the deep sea.

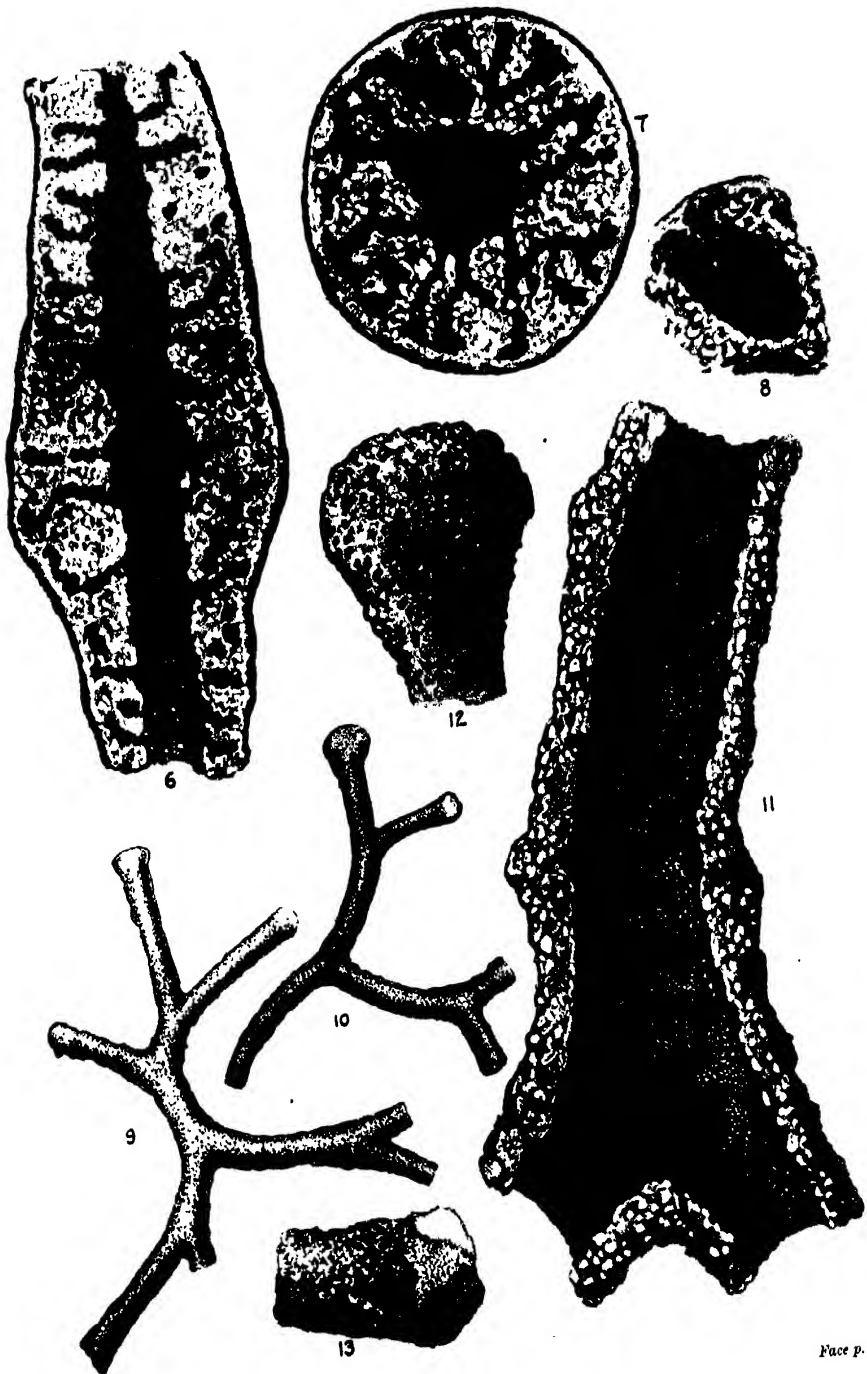
SCHIZAMMINA LABYRINTHICA sp. nov.

Plate I, figs. 3-5. Plate II, figs. 6-8. Plate III, fig. 14.

Test large, free, arenaceous, an unseptate sandy tube circular in section, branching dichotomously, and usually in one plane. The walls of the test are of almost uniform diameter throughout, but some specimens show a tendency to form areas of constriction and expansion, which possibly mark either stages of growth or abundance (or *vice versa*) of food-supply. They appear to be confined to the wall only, as the internal tube is practically constant in calibre throughout growth.

The surface of the test is smoothly finished, but not polished, rusty brown in colour except at the extremities of the arms, which are generally light grey, and formed of a cap of loosely agglutinated sand grains devoid of cement, covering in the aperture of the central tube. In some instances the central cap is open at the extremity, but, whether open or closed, there

* "On the genus *Botellina* Carpenter, with a Description of a New Species," by F. Gordon Pearcey, in *Trans. South African Phil. Soc.*, 1908, vol. xvii, pt. 2, pp. 185-94, pl. xx.
 † *Rhabdammina irregularis* W. B. Carpenter. *Proc. Roy. Soc., Lond.*, 1869, xviii, p. 60; (Brady), *Rep. Challenger, Zoology*, vol. 9, 1884, p. 268, pl. xxi, fig. 9; (Goës), *Bull. Mus. Comp. Zool.*, vol. 29, 1896, p. 21; (Rhumbler), *Arch. Protistk.*, vol. 3, 1903, p. 263, fig. 106 (text); (Cushman), *U.S. Nat. Mus. Bull.*, 71, 1910, p. 26, figs. in text.



is no doubt that all the extremities serve as apertures for the extrusion of protoplasm. This has been observed in the well-preserved material.

In section, whether broken or ground down, it is seen that the smoothly-finished external wall is very thin, and that it surrounds a much thicker internal wall of a yellowish colour, formed of firmly-cemented sand grains, which in turn surrounds the central tube. This inner wall is labyrinthic, being traversed in all directions by a series of ramifying canals which originate in large oscules, studded all over the inner wall of the central tubular cavity, the surface of which is rough and irregular, owing to the number of these oscules and the larger size of the constituent sand grains compared with those of the external and superficial layer.

The canals are generally broad, but they become finer as they penetrate the shell wall, and they stop at the inner surface of the external wall. It is quite certain that they do not penetrate this external wall, although it may be permeable to fluids through adventitious openings between its constituent grains. At intervals the canals broaden out into bulbous chamberlets, which are of considerable size as compared with the total thickness of the wall.

The specimens received had been fixed at the time of capture and preserved in alcohol. The protoplasmic body is large, of the usual dark colour, and apparently filled, and was confined to the central branching tube. No extension of the dark protoplasm into the labyrinthic canals has been observed, except the presence of a stercome (digestion product) in one of the bulbous chamberlets above referred to, which was exposed in a fractured specimen (fig. 8). As there is no other sign of protoplasm in the chamberlet, its presence may be incidental to the fracture.

The absence of dark-coloured protoplasm in the labyrinthic layer raises the question of the function served by that structure. Three possible explanations suggest themselves :—

(1) Its only purpose may be to strengthen the test with a minimum expenditure of building material.

(2) Assuming the porosity of the external layer, it may serve as a vascular system by means of which fluid is conveyed to the protoplasm in the internal tube, or by means of which the surplus water in the food collected by the protoplasm extruded through the apertures is returned to the surrounding medium.

(3) The labyrinthic passages may in life be filled with reserves of protoplasm not engaged in digestive functions and therefore colourless.

The first theory seems to us the more convincing, but it leaves the bulbous chamberlets unexplained.

There is no evident primordial chamber, and no immature specimens were received with the *Discovery* material. We assume that *Schizammina* starts life as a simple straight tube, open at both ends, and that it increases in size by the bifurcation of an extremity and the subsequent bifurcation of the two arms thus formed. In this species the bifurcation appears to be

almost exclusively confined to one extremity of the tube, the other remaining unchanged in structure through life, though it may, and probably does, increase in diameter. In a few instances this initial tube is of smaller diameter than the subsequent branches, but as a general rule there is no great disparity. One fragmentary specimen of *S. labyrinthica* has been seen exhibiting bifurcation of both extremities of the original tube.

It is obvious from its plane structure that *Schizammia* lives flat on the surface of the ooze, and is thus enabled to feed over a maximum of surface. It never branches in an arborescent manner, as do those organisms which are basally fixed.

Dimensions.—An average specimen would fill a circle approximately 1 in. in diameter. Broken individuals indicate that it may attain at least twice that size, but, owing to the brittleness of the test, such specimens are probably rare. The average diameter of the branches is about 1.8 mm.; the greatest diameter observed (other than at point of bifurcation, where the diameter increases temporarily) was 2.5 mm. This was in a specimen where the branch became swollen at mid-length. As already mentioned, these swellings are confined to the thickness of the wall, and do not indicate any septum or increase in diameter of the central tube. The canals in the labyrinthic wall vary greatly, the maximum diameter being about 0.13 mm.; the largest bulbous chamberlet observed, the one containing the stercome, measured 0.3 mm. in greatest diameter. This was exceptional, as it occupied nearly the entire thickness of the wall, which only measured about 0.5 mm. at that spot. The diameter of the central tube averages 0.5 mm.; the oscules opening out of it vary greatly in size and shape from circular to oval. They range between 0.05 mm. and 0.2 mm. in greatest diameter. The larger oval oscules probably represent the opening into two diverging canals. In a longitudinal section which was cut, the maximum diameter was 2.30 mm., the central tube at that point was about 0.6 mm., and the two labyrinthic walls accounted for 1.70 mm. The external layer, which was too thin and broken for measurement, must have been under 0.01 mm. in thickness.

SCHIZAMMIA FURCATA sp. nov.

Plate II, figs. 9–13. Plate III, figs. 15–16.

Test free, arenaceous, an unseptate sandy tube branching dichotomously in one plane. Smaller and more slender in construction than *S. labyrinthica*, it differs also in several features. The arms vary from circular to elliptic in section, and are frequently a flattened ellipse. They are more uniform in diameter, and seldom present those areas of constriction and expansion which mark the other species. In colour they are yellowish brown, superficially rough, strongly constructed with moderately large sand grains, and almost entirely devoid of the smooth finish characterising the external layer of *S. labyrinthica*. What we have termed the external wall in *S. labyrinthica*

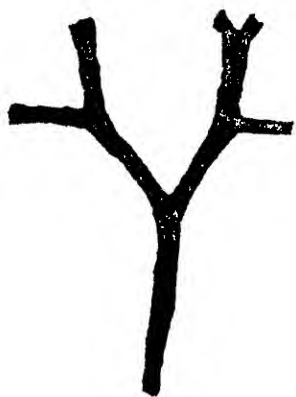


FIG. 15



FIG. 16

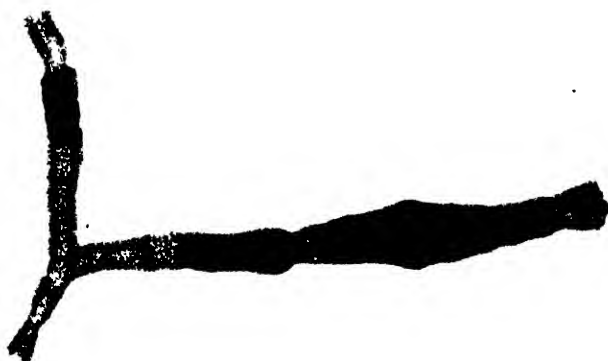


FIG. 14

is frequently quite unrecognisable in *S. furcata*, and never develops to any marked extent. The external surface of *S. furcata*, in fact, is typically Rhabdammine, and a broken specimen might easily be mistaken for *Rhabdammina irregularis* Carpenter.

A section reveals marked differences between the two. *R. irregularis* presents an internal tube with firmly agglutinated sandy walls traversed by slight ridges corresponding to the rugosities on the external wall. *S. furcata* has a much broader internal tube, the inner surface of which is extremely irregular and rough in surface owing to the presence of innumerable cavities of varying sizes. These correspond to the oscules of the labyrinthic layer in *S. labyrinthica*, but owing to the comparative thinness of the wall, which averages three sand grains only in thickness, they do not form ramifying canals, but are more of the nature of superficial pits. They do not extend as far as the outermost layer of sand grains.

The central tube of *S. furcata* is wider in proportion to the total diameter of the test than in *S. labyrinthica*. The protoplasm is dark in colour, copious, and extends throughout the entire tubular system. The terminal apertures are similar to those in *S. labyrinthica*.

Apart from the differences mentioned above, which are ample for specific distinction, *S. furcata* corresponds very nearly to *S. labyrinthica*. It may represent a stage in the development of the latter species from a typical *Rhabdammina*, or it may be a degeneration from *S. labyrinthica*. As in *S. labyrinthica*, growth is usually obtained by the bifurcation of one extremity only, but many specimens have been found exhibiting bifurcation at both ends.

Dimensions.—An average specimen occupies a circle about $\frac{3}{4}$ in. in diameter, but fragments of much larger individuals have been found probably of double that size. The larger specimens are frequently irregular in their growth and branching. Diameter of branches varies from 0.80 mm. to 1.20 mm. In section the internal tube varies from 0.40 mm. to 0.80 mm., while the outer wall is only about 0.18 mm. in thickness. These measurements are in strong contrast with *S. labyrinthica*. The oscules are smaller, ranging from 0.03 mm. to 0.10 mm. in diameter.

After the completion of this paper we were so fortunate as to induce Mr. J. E. Barnard, F.R.S., President of the Society, to skiagraph *Schizammia*, with the view of confirming those structural details which had been laboriously interpreted from somewhat unsatisfactory sections of the material. Mr. Barnard's pictures are reproduced on plate III, and illustrate the various points mentioned in the paper. We wish to express our gratitude for his assistance and our admiration for these unique results of his technical skill, which, in our opinion, mark an advance even upon his earlier skiagraphs of foraminifera.

PLATE I.

- Fig. 1.—*Sorosphaera depressa* sp. nov. Colony of individuals attached to a stone. Several specimens show openings due to accidental fractures. $\times 8$.
 Fig. 2.—*Sorosphaera depressa* sp. nov. A younger colony attached to a flexible organic base. $\times 25$.
 Fig. 3.—*Schizammmina labyrinthica* gen. et sp. nov. The arm pointing to the left is the initial portion of test. $\times 3$.
 Fig. 4.—*Schizammmina labyrinthica*. Terminal portion of a branch. No visible aperture, the extremity being covered with a loosely agglutinated sandy cap. $\times 8$.
 Fig. 5.—*Schizammmina labyrinthica*. Terminal portion of a branch exhibiting aperture. $\times 8$.

PLATE II.

- Fig. 6.—*Schizammmina labyrinthica*. Longitudinal section, cut somewhat obliquely, showing the thin external wall, the thicker internal labyrinthic layer, and the central tubular cavity with oscules opening into canals of the labyrinthic layer. $\times 22$.
 Fig. 7.—*Schizammmina labyrinthica*. Transverse section showing the same features; also expansion of a canal into a chamberlet containing stercomes. $\times 36$.
 Fig. 8.—*Schizammmina labyrinthica*. The same chamberlet with stercomes. $\times 50$.
 Figs. 9, 10.—*Schizammmina furcata* sp. nov. Fig. 10 represents an individual of normal growth, increasing only by fission of one extremity of the initial portion of test (pointing left). The topmost branch is preparing to divide again. Fig. 9 represents an abnormal individual which has grown by division of both extremities of the initial portion (in middle). $\times 5$.
 Fig. 11.—*Schizammmina furcata*. Longitudinal section showing oscules in the wall of internal tube, and the solid wall devoid of labyrinthic layer. $\times 22$.
 Fig. 12.—*Schizammmina furcata*. Terminal portion of a branch which is preparing for fission by the formation of a wide flattened extremity. $\times 22$.
 Fig. 13.—*Schizammmina furcata*. Terminal portion of a branch, showing the loosely agglutinated cap of sand covering aperture. $\times 22$.

PLATE III.

Skiagraphs made by J. E. Barnard, F.R.S., President of the Royal Microscopical Society.

- Fig. 14.—*Schizammmina labyrinthica*. Showing unseptate tube, labyrinthic wall and oscules. $\times 4$.
 Fig. 15.—*Schizammmina furcata*. A young individual showing unseptate tube and simple wall. The uppermost extremities are closed with loosely agglutinated sand caps. $\times 3$.
 Fig. 16.—*Schizammmina furcata*. Showing unseptate tube and simple wall. The three uppermost extremities are in process of division. $\times 3$.

VII.—THE MICROSCOPIC ANATOMY OF THE VASCULAR SYSTEM OF THE DOG'S SPLEEN.

By P. L. LI, M.B., H. S. D. GARVEN, B.Sc., M.D.,
and R. HOWARD MOLE, B.A., M.D.

From the Laboratory of Pathology, Moukden Medical College.

FOUR PLATES AND ONE TEXT-FIGURE.

1.—*Material and Methods.*

BARCROFT (1927) has shown by his studies on the extra-cutaneous spleen and in other ways that the size of the spleen is very variable. In making preparations for the study of the minute anatomy of the spleen, we have made use of this fact in the following way. In the anæsthetised dog we partially clamped the splenic veins and allowed the organ to enlarge by increased afflux of blood. Later we found that splenic distension can be equally well achieved by removing the spleen with its vessels and mesentery, inserting a cannula into the splenic artery, and connecting this with a pumping apparatus containing in its system a Hg-manometer. Normal saline or Ringer was used in our reservoir. Brief details follow of the technique employed in the various animals used.

Dog O.—Under ether anæsthesia the splenic veins were partially clamped and the organ allowed to enlarge by increased afflux of blood from its own arteries. The organ, with its mesentery and its clamped vessels, was removed from the body. A cannula was inserted into the artery and connected with a pumping apparatus. The fluid used was Ringer. When the venous return was partially released, and the Ringer pumped in, the organ in its head end and body increased in size, and its colour changed from a dark purple to a light pink. The tail of the spleen did not increase in size nor did it change colour. It was discovered that the branch of the artery supplying the tail end of the spleen arises from the splenic artery a good way distal to the spleen, and distal, in this case, to the cannula. The pressure employed here was not noted, but was high. Finally 10 p.c. formalin in saline was pumped into the organ, and it was placed in a jar containing the same fluid.

Dog A.—Under ether anaesthesia the dog was first bled. The spleen contracted, and was removed in the contracted condition with its vessels and mesentery. Saline was pumped in as above described, and the organ, except for its tail end, enlarged. Subsequently an emulsion of chicken's red blood corpuscles in saline was injected by a syringe into the enlarged spleen through the artery. Finally 4 p.c. formalin in saline was pumped in, and the organ preserved in the same fluid. Manometer pressure 160–180 mm.

Dog B.—The preliminary steps were as in dog A. In this case, however, after the preliminary pumping up of the spleen by saline, a thin suspension of chicken's red blood corpuscles in saline was substituted for the saline in the reservoir, the organ being kept in the enlarged condition. 4 p.c. formalin in saline was pumped in, and the organ preserved in the same fluid. Manometer pressure 160–180 mm.

Dog C.—In this animal, after the first pumping up with saline, the organ was allowed to contract by the release of the vein, and then the process was repeated. Manometer pressure 160–180 mm. Subsequently, the spleen being in the contracted position, the artery was clamped, a cannula inserted in the vein, and chicken's corpuscles in saline pumped in. The organ in this case very quickly enlarged—more quickly than in the previous dogs—and became larger than when the injection was done through the artery. There was marked sweating of the external surface of the spleen, although the manometer registered only 40–60 mm. Finally 4 p.c. formalin in saline was pumped in, and the organ preserved in the same fluid.

Dog D (Puppy).—This dog was treated as dog O.

Dog E.—This dog had two big accessory spleens and a great number of red nodules scattered in the mesentery, which were also of the nature of accessory spleens. In this case the branch of the artery which supplied the tail of the main spleen supplied also the tail accessory spleen, while the remainder of the artery supplied the body and head of the main spleen, and also the head accessory spleen.

The main and the two large accessory spleens were all treated (except as regards chicken corpuscles) as described under dog A, etc., and Indian ink was injected into the organ through the veins. In the case of one of the spleens Prussian blue was also injected into the artery.

In addition to the dogs detailed above, the spleen of a newly still-born baby and also that of a pig were treated (except as regards chicken corpuscles) as described under dog A. Indian ink was injected through the artery in each case. The baby's spleen was preserved in 4 p.c. formol saline; formol saline was injected into the artery of the pig's spleen, and the organ was preserved in the same fluid.

From all the above spleens large numbers of serial sections were made from various parts of the organ. For staining, logwood and van Gieson were employed as the routine procedure. Eosin and methylene blue, the Azan method, and Foot Ménard's (1927) method of silver impregnation were also employed.



FIG. 1



FIG. 2



FIG. 3

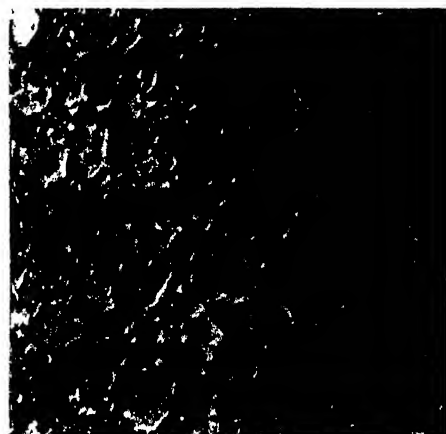


FIG. 4



FIG. 5

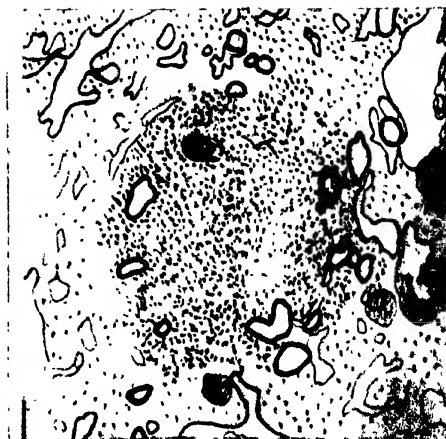


FIG. 6

2.—*The General Arrangement of the Blood Vessels Within the Dog's Spleen.*

Both artery and vein within the trabecula have a loose connective tissue sheath separating them from the fibro-muscular structure of the trabeculum. In this loose connective tissue are nerve bundles. As the artery branches pass from the main trabecula into the pulp, the connective tissue sheath disappears, and the trabecular tissue becomes closely applied to the outer coat of the vessels (fig. 1). In this way the artery at this stage appears like a four-coated vessel. In the case of the vein it is difficult to distinguish adventitia from trabecular coat. From near the point of entrance of the main artery into the spleen a small branch may arise which acquires only one malpighian corpuscle and ends in the neighbourhood of the entrance of the main vessel. The veins all course in trabecula, and the wall of each vein is connected with others and with the capsule by trabecular bands.

Occasionally, where in the pulp the artery and vein are near each other, or the course of one crosses that of the other, they are connected by fibrous bands.

In the smallest four-coated arteries the trabecular coat and adventitia tend to become intermingled, and the next stage is a three-coated vessel. Both four-coated and three-coated arteries may acquire a lymphoid sheath and malpighian corpuscles (fig. 1). Malpighian corpuscles seem to occur at the place of branching of the artery, and this situation suggests that they provide here a mechanical support for the artery. In a suitable specimen one may see a series of malpighian corpuscles along the course of the artery where its branches are given off (fig. 2). These corpuscles are in a descending series in size as the branches of the vessel become smaller.

Later the third coat of the artery is also lost, and the arteriole consists of an endothelial lining with a fibro-muscular coat. The smaller malpighian corpuscles surround two-coated vessels. The position of the vessel within the corpuscle is excentric.

While the artery is in the malpighian corpuscle it gives off two-coated branches, which leave the corpuscle and break up into penicillia in the pulp. It also gives off capillaries to the substance of the corpuscle. The branches, on leaving the corpuscle, have for a time a thin lymphoid sheath surrounding them. The penicillia have only an endothelium and a small amount of connective tissue external to the endothelium.

The penicillar branches each acquire one ellipsoid or more—a sheath composed of reticulo-endothelial cells with a small amount of reticulum. Within the ellipsoid the vessel reaches the smallest diameter—that of a red blood corpuscle. Within the ellipsoid, too, the vessel may branch two or three times, and as it branches the ellipsoid sheath branches with it. After leaving the ellipsoid, the capillary dilates a little and then bifurcates (fig. 3). Each bifurcated branch is of considerable length, and its terminal part dilates into the so-called “blind chamber” (figs. 3 and 4). In the spleens

we have examined, this chamber is not blind, but communicates with the pulp, the endothelium of the capillary becoming continuous at its extremity with the reticulo-endothelial cells of the pulp (fig. 5).

At the margin of each malpighian corpuscle are the terminations of the penicillar branches derived from the arteries of the malpighian corpuscles, so that many ellipsoids are to be seen at the periphery of a malpighian corpuscle (fig. 6). There seems, indeed, to be a blood-channel in the pulp surrounding a malpighian corpuscle into which enter the terminations of capillaries from within itself, as well as the terminations of capillaries derived from other external arteries. Ellipsoids are also scattered throughout the pulp.

3.—*The Penicillia.*

The penicillia of the dog's terminal arteriole differ in their arrangement from those of the baby's spleen. In the latter each arteriole ends in a cluster of small vessels, each of which acquires an ellipsoid (fig. 7), whereas in the dog the terminal arteriole gives off side branches which acquire ellipsoids, while its terminal branches number only two or three.

4.—*The Ellipsoids.*

The ellipsoid is a sheath of reticulo-endothelial cells, with their processes, surrounding the sub-terminal portion of the capillary before it passes into the "blind chamber." When the silver impregnation method is used, fine particles and lines of reticulum are also seen. These, however, can be seen only with the oil immersion lens. The innermost layer of reticulo-endothelial cells making up the ellipsoid is placed at some little distance from the capillary wall, the processes of these cells being attached to the wall (fig. 8). The ellipsoid is usually fusiform in shape and of varying thickness. Complicated shapes of ellipsoid are due to the branching of the capillary within, for with each branching of the capillary there also occurs a branching of the ellipsoid. Most of the penicillar capillaries acquire an ellipsoid—or sometimes more than one—but ellipsoids are absent from some of the capillaries opening into the peri-malpighian blood channel; they are also absent from the capillaries which supply the corpuscle, both from those arising within and from those outside the corpuscle which pass into it (fig. 9).

The reticulo-endothelial cells of the ellipsoid generally contain pigment granules (fig. 8). When the Prussian blue reaction is employed, these granules are found for the most part to contain Fe. The ellipsoid contains Fe pigment in greater aggregations than occur in the reticulo-endothelial cells of the pulp. In dog A golden brown Hb pigment was also seen in the endothelium of the capillary.

In the spleen injected with Indian ink the ellipsoids took up readily the C pigment and became black in colour, while in the animals receiving chicken's corpuscles none were observed in the ellipsoid sheath.



FIG.7

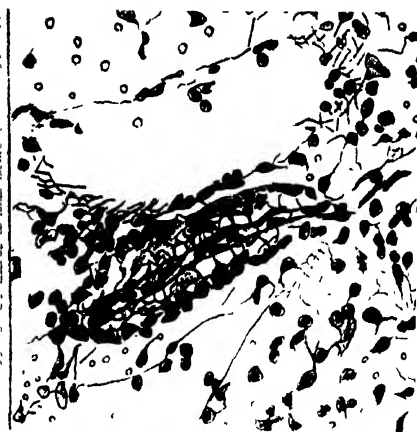


FIG.8



FIG.9



FIG.10



FIG.11



FIG.12

The question at once arose as to why the Indian ink particles, when injected through the splenic artery, were often more particularly localised in the ellipsoid (fig. 10), while the surrounding pulp was comparatively clear. Careful search was made for any openings in the wall of the capillary contained within the ellipsoid of the dog's spleen through which such ink particles might pass to the interstices of the sheath, but none were found, neither were any openings observed in the wall of the ellipsoid capillary of the baby's spleen. In the spleen of the pig, however, such openings were clearly seen (fig. 11), and show well in the accompanying picture. It is probable, therefore, that such are present also in the ellipsoid capillary of the dog.

Tait (1927), referring to the ellipsoid of the skate's spleen, states that it is composed of sessile phagocytic cells which capture foreign particles introduced into the blood stream, and probably also ingest effete corpuscular elements of the blood. After ingestion these cells migrate into the parenchyma. The skate's ellipsoids also contain a finely meshed reticulum continuous with the general reticulum. Tait offers no adequate explanation as to how the foreign or native particles leave the blood, though he suggests a theory which will be referred to later. The occurrence of openings in the ellipsoid capillary wall of the pig's spleen explains how the ellipsoid may function as a filter for small foreign particles. An explanation is also forthcoming of how fragmented blood corpuscles may within the ellipsoid be removed from the circulation. It has been stated above that the capillary within the ellipsoid is extremely narrow. The part of the capillary proximal to and the part distal to the ellipsoid are both of larger diameter. This would also, by slowing the blood flow, assist the ellipsoid in its filter function.

The ellipsoid is always in more or less close relationship to the blood sinuses. The micro-photograph (fig. 12) shows an ellipsoid completely surrounded by sinuses, and not infrequently an ellipsoid forms part of the boundary of a sinus or actually projects into it. It is suggested that this arrangement makes it possible for the plasma, which escapes with the fine particles from the blood within the ellipsoid capillary, to pass directly to the sinus.

5.—The "Blind Chamber."

The capillary, after passing through the ellipsoid, bifurcates, although this bifurcation may take place within the ellipsoid. Each of these two branches is long, and ends in a dilated ampulla. The "blind chambers" in the peri-malpighian zone are less dilated than those lying in the general pulp. The "blind chamber," like the capillary, is lined by endothelium, except at its terminal point, where the endothelium becomes continuous with the reticulo-endothelial cells of the pulp (fig. 5). In dog A, where a few cells of chicken's red blood corpuscles were injected into an already enlarged spleen, these corpuscles can be seen lying at the end of the ampulla and also in the pulp. In dog B, whose spleen received chicken's corpuscles in quantity,

the end of the ampulla is sometimes choked with these cells (fig. 13). The wall of the "blind chamber" has sometimes a fenestrated appearance comparable with that of the wall of a splenic sinus.

6.—*The Splenic Sinuses and Veins.*

In the spleen treated as above described the sinuses are dilated and empty, and can be well seen. They are not of the same size, and, except as narrow channels, visible only with high powers of the microscope, cannot be seen in the zone immediately surrounding the malpighian corpuscle. The sinuses are inter-communicating, and open into the veins (figs. 14 and 15). Where the sinus opens into the vein a wide gap in the wall of the vein is apparent. Oftentimes several sinuses are seen entering a vein in one plane (fig. 14). The weakness which this factor introduces is counterbalanced by the trabecular bands which connect the walls of the veins with each other and with the capsule.

The wall of the splenic sinus is fenestrated, and the processes of the fenestration run both longitudinally and transversely (fig. 16). In sections impregnated with silver by the Foot Mênard method the transverse striations are picked out in black, while the cell body and nucleus of the reticulo-endothelial cells are stained grey. No longitudinal striations appear when this method is used. The wavy transverse striations do not connect at all, are roughly parallel with each other (fig. 17), and are fixed on either side to the wall of the sinus. The differences in the appearance of the sinus wall when observed in logwood van Gieson preparations on the one hand and in silver preparations on the other are sufficiently striking. In the former case both transverse and longitudinal striations stain equally, and the reticulo-endothelial cell bodies lie at right angles to the transverse striations. In the latter case, as has been said, only the transverse striations take the silver, and one is led to suppose that the longitudinal striations seen in the former are the processes of the reticulo-endothelial cells. In other words, here reticulo-endothelial cells and their longitudinally running processes are applied to a transversely arranged reticulum.

If this be the case, the size of the holes in the fenestrations may be controlled during life by the contraction and relaxation of the protoplasmic processes of the reticulo-endothelial cells.

In Mollier's description (1911) of the structure of the sinus wall (man and dog), he also distinguishes a protoplasmic and a reticular layer. He states, however, that the reticular layer is composed of both longitudinal and transverse portions, though the transverse striations are coarser than the longitudinal. In the protoplasmic layer he says that the processes of the reticulo-endothelial cells run both transversely and longitudinally, the longitudinal being coarser than the transverse processes.

No instance was observed of an ellipsoid capillary opening into a sinus, although the micro-photograph (fig. 12) suggests such a possibility.



FIG.13



FIG.14

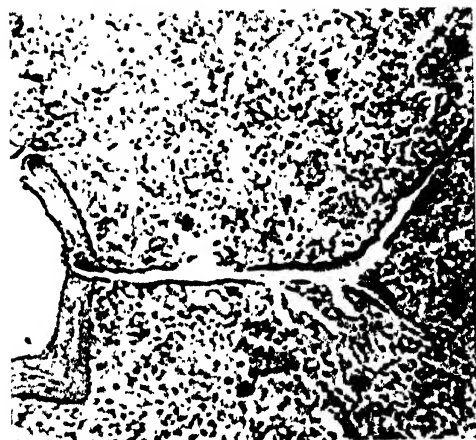


FIG.15



FIG.16

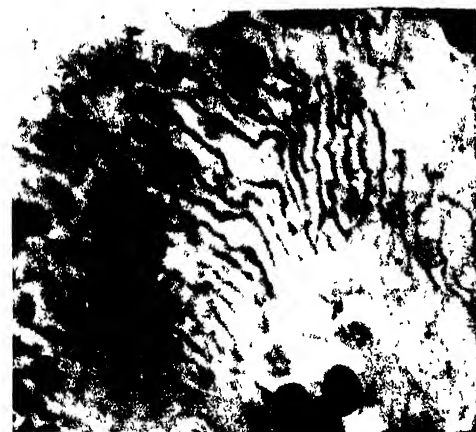


FIG.17

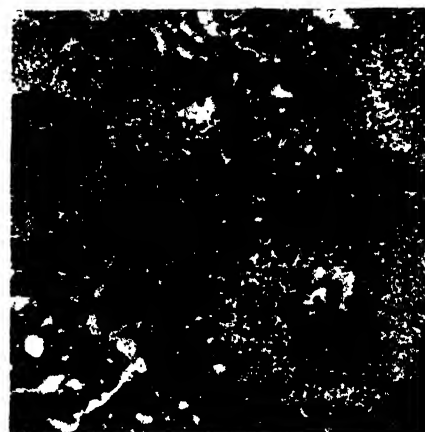


FIG.18

Krumbhaar (1926), in his paper summarising the present knowledge of the functions of the spleen—appended to which is a full bibliography—states that the splenic sinus has a peculiar structure comparable to barrel hoops enclosing fenestrated staves, and may receive blood components either through fenestrations or by tube-like branches draining directly from the pulp. We saw no evidence of such tube-like branches.

Tait asks the question how, in the skate's spleen, the junction of endothelium with reticulum is effected in the ellipsoid and in the sinus wall, and associates the porosity of the ellipsoid capillary wall and that of the sinus wall with the intrinsic difficulty of attaching endothelial cells to reticular fibres. He states that in the skate, where the endothelial lining of the sinus is apparently complete, the endothelium is attached to delicate truncated or amputated ends of microscopic brushes which jut out from the reticulum.

With regard to splenic contractility, Krumbhaar states that there is :
(1) a slow expansion and contraction, related to digestive functions, and
(2) a more rapid systole and diastole with intervals of about one minute, which Roy found in dogs and cats, carried on by a rhythmic contraction of the muscles of the capsule and trabecula.

Since the vein walls are all interconnected, and also connected with the capsule of the organ, splenic contraction must dilate the veins and cause the blood in the pulp to pass by suction and pressure into the sinuses and thence into the veins.

Barcroft (1923-5) has directed attention to the "bank" or "reservoir" function of the spleen, and C. S. Yang (1928) has shown that in man adrenalin produces a marked decrease in the size of the spleen in all cases of splenic enlargement, with an increase of Hb and red cell count in the peripheral circulation, that in normal individuals there is also an increase in Hb and red cell count, though to a less degree, while in splenectomised patients there is no such increase; and the suggestion is made that this effect is due to mechanical squeezing.

7.—The Blood Channel Surrounding the Malpighian Corpuscle.

In dog O micro-photograph (fig. 18) the immediate neighbourhood of the malpighian corpuscle shows a zone surrounding the corpuscle, with no apparent sinuses when seen with a low power of the microscope, and staining more lightly than the surrounding pulp.

In dog A this zone contains chicken's corpuscles. In dog B (fig. 19) a complete zone of chicken's corpuscles can be seen surrounding the corpuscle.

Where Indian ink was injected into the artery the area surrounding the corpuscle shows in almost every case a complete zone of Indian ink particles (fig. 10).

The micro-photograph (fig. 7) shows how in the baby's spleen the penicillar vessel clusters surround the malpighian corpuscle.

These facts suggest that in the peri-malpighian zone is situated one of the avenues by which the arterial blood channel opens out into the spleen pulp. Into this zone there enter three sets of arterial capillaries :—

- (1) The “blind chamber,” or terminations of the ellipsoid capillaries derived from the arteries of other malpighian corpuscles (fig. 20).
- (2) Terminations of capillaries derived from its own corpuscular artery, which, passing out of the corpuscle, attain ellipsoids (fig. 21), bifurcate, and turn back in a recurrent manner.
- (3) Capillaries, arising from its own artery and supplying its substance, seem to pass outside and open into the channel.

Further, narrow channels seem to connect this peri-malpighian zone with the venous sinuses.

When Indian ink was injected into the organ by the venous route, the sinus linings took up the particles and also the pulp cells. There seems also a peri-malpighian faintly marked black zone around the corpuscle, but this is not by any means as clear as the zone seen after injecting the ink by the arterial route. Where chicken's corpuscles were injected by the venous route, no such zone was found, but a very few chicken's corpuscles were sometimes seen here. No Indian ink or chicken's corpuscles were found in the ellipsoid. Tait used this method also and found the ink particles in the sinus linings and in every available part of the reticulated interior of the spleen, but not in the ellipsoids.

We have found no evidence, then, of short-circuiting in this peri-malpighian blood channel, i.e. no direct arterio-venous communication.

Robinson (1926), in his study of the vascular system of the spleen, concludes that there are no direct communicating closed channels between arteries and veins other than the pulp spaces.

Krumbhaar, in his review of the vascular system of the spleen, mentions two places where this direct arterio-venous connection may exist :—

- (1) Capillaries given off from the follicle artery may connect directly with a venous sinus.
- (2) The capillary terminations of the hulsen arteriæ or ellipsoid capillaries may, as an alternative to the blind chamber form of ending, connect directly with a sinus. We saw no definite traces of either of these direct communications.

From the specimens we have examined we cannot, therefore, say whether such direct arterio-venous communications exist. Direct ellipsoid-capillary-sinus plasma communication seems possible, judging from the appearances in the pig's ellipsoid.

8.—*General View of the Circulation of the Blood in the Dog's Spleen.*

The diagram (fig. 22) represents our view of the splenic circulation. Blood enters the pulp from the termination of the “blind chamber,” situated

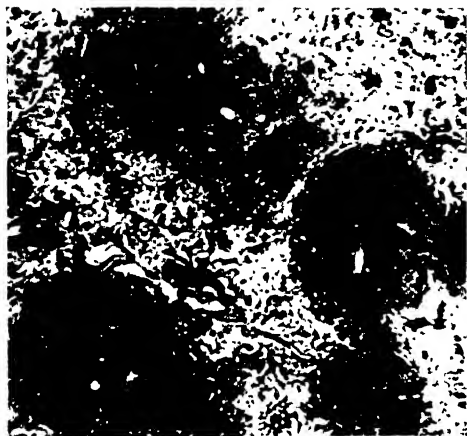


FIG.19

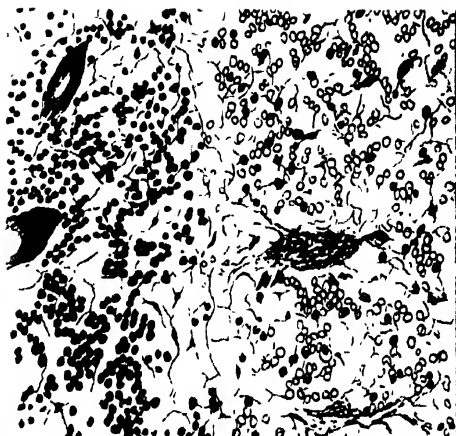


FIG.20

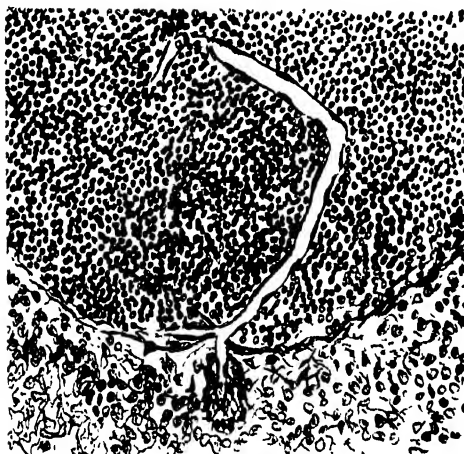
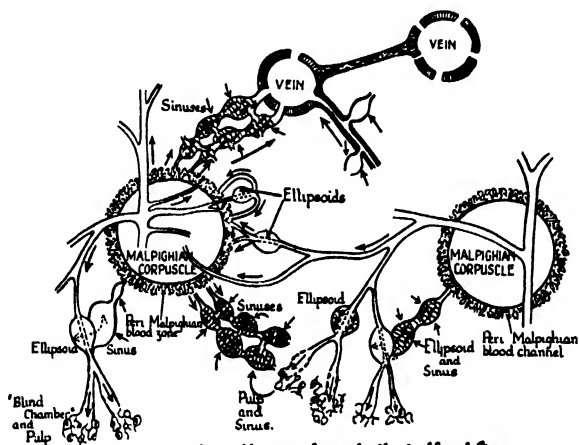


FIG.21

partly at the periphery of the corpuscle and partly throughout the pulp. Splenic contraction causes the blood in the pulp to pass by suction and pressure into the sinuses, through their fenestrated walls, and thence into the veins.



Arrows with continuous lines indicate blood flow.
Arrows with discontinuous lines indicate plasma and particle flow.

FIG. 22.—The Splenic Circulation of the Dog.

Small particles in the blood may pass out from the ellipsoid capillary and be phagocyted by the reticulo-endothelial cells of the ellipsoid, and plasma may pass from the ellipsoid capillary directly to a sinus.

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NOTE.

Just as this paper is being offered for publication, there has come to hand the February number of the *Archives of Pathology*, in which is contained a paper on "The Circulation of Blood through the Spleen Pulp," by Ward J. MacNeal of New York. This touches upon many of the points discussed in the writers' own paper. Some of MacNeal's conclusions are similar to those presented here, while some are different. MacNeal's work has been done on the human spleen and on that of the rabbit.

A short summary of MacNeal's paper follows, in so far as its conclusions have reference to the writers' own findings:—

The unit of the spleen is the splenic lobule. A lobule consists of the malpighian corpuscle, with a marginal or intermediate zone at its periphery, containing small arterial capillaries

and a close meshwork of reticulum and pulp cells. The outer layer of the lobule contains venous capillaries and sinuses, the largest sinuses being situated externally, and between the sinuses are pulp cords.

The follicle itself has a capillary system arising from its own artery or branches. These capillaries anastomose within the follicle and at its periphery. The capillary system ends by short twigs which extend into the marginal zone and there communicate with the intercellular spaces.

In the spleen distended by perfusion the marginal zone is free from venous capillaries.

The arterial blood-vessels of each lobule are terminal, without anastomosis with arterial vessels of other lobules. There are three kinds of capillaries—

- (1) The anastomosing capillary plexus of the follicle, which arises from the excentric arteriole or a branch of it.
- (2) The centripetal capillaries of the marginal zone, which arise from a sheathed branch of the intralobular artery.
- (3) The long capillaries of the pulp cords, which arise from the same sheathed arteriolar branches.

The arterial capillaries of the follicle and the centripetal capillaries open out into the intercellular pulp spaces of the marginal zone at considerable distances from the nearest venous sinuses. The arterial capillaries of the pulp cords terminate in more or less well-defined ampullæ within the substance of a pulp cord, but separated from the adjacent venous sinuses by a thin layer of the pulp.

The intercellular spaces of the pulp constitute the essential pathway through which blood must pass from the termination of the arterial capillaries to reach the first vessels of the venous system. The splenic circulation is an open circulation. The rate of passage is slow in these spaces and is influenced by (1) arterial pressure, (2) the contraction of muscle in the capsule and trabeculae, (3) the contraction of the reticular cells and the rod cells lining the venous sinuses.

The sinus walls are composed of rod-shaped endothelial cells, with large oval nuclei that project into the lumen. These cells are sometimes attached to each other by protoplasmic processes, but in general are separated by parallel longitudinal clefts which are crossed at intervals by reticular strands external to the rod cells and continuous with the pulp reticulum.

With regard to the marginal or intermediate zone of the lobule, it is stated that this zone is the most important part of the lobule, as far as action on the formed elements of the blood is concerned.

The physiological significance of the ellipsoid sheaths is stated to be not fully elucidated. "They doubtless have something to do with regulating the lumen of the arterial vessel in the interior. The suggestion that the ellipsoids permit the passage of plasma through their substance and thus act chemically on dissolved substances in the fluid portion of the blood seems worthy of consideration."

EXPLANATION OF PLATES.

PLATE I.

- Fig. 1.—Four-coated artery passing through a malpighian corpuscle. $\times 118$.
 Fig. 2.—A series of malpighian corpuscles situated at the points where branches leave an artery. $\times 23$.
 Fig. 3.—A capillary emerging from an ellipsoid, bifurcating, and ending in dilated ampullæ ("blind chambers"). The endothelium of the ampullæ is continuous with the reticulo-endothelial cells of the pulp. $\times 400$.
 Fig. 4.—A capillary within an ellipsoid, with one of its terminal dilated ampullæ. $\times 420$.
 Fig. 5.—A terminal dilated ampulla. The endothelium of the ampulla is continuous with the reticulo-endothelial cells of the pulp. $\times 1000$.
 Fig. 6.—Camera-lucida drawing. The ellipsoids, outlined in black, lie at the borders of a malpighian corpuscle. $\times 80$.

PLATE II.

- Fig. 7.—Baby's spleen. Artery injected with Indian ink. A small piece of spleen was teased out and crushed between a cover slip and slide. The pale central part is the malpighian corpuscle. The artery and its branches pass through the corpuscle, and clusters of penicillar branches surround it. $\times 27$.

- Fig. 8.—Camera-lucida drawing. Capillary within an ellipsoid. Pigment containing reticulo-endothelial cells of the ellipsoid are attached by their processes to the capillary wall. A venous sinus is contiguous to the ellipsoid, and fragments of its fenestrated wall are seen. $\times 330$.
- Fig. 9.—Camera-lucida drawing. Termination of an artery outside an ellipsoid. One branch attains an ellipsoid, a second opens into the peri-malpighian blood channel, and a third enters the corpuscle. $\times 330$.
- Fig. 10.—Indian ink injected into the splenic artery. The small dark areas in the pulp are for the most part ellipsoids containing pigment. A peri-malpighian zone of pigment is also seen. $\times 46$.
- Fig. 11.—Pig's ellipsoid. Camera-lucida drawing. Openings in the ellipsoid capillary wall are seen, with pigment granules lying near the openings. The artery was injected with Indian ink. $\times 324$.
- Fig. 12.—An ellipsoid surrounded by sinuses. Capillary within the ellipsoid does not open into sinus. $\times 1000$.

PLATE III.

- Fig. 13.—Terminal ampulla ("blind chamber") choked with chicken's red blood corpuscles. Splenic artery had been injected with chicken's red blood corpuscles. $\times 1000$.
- Fig. 14.—Large vein receiving several sinuses in the same plane. $\times 20$.
- Fig. 15.—Small vein, after receiving several sinuses, entering large vein. $\times 95$.
- Fig. 16.—Fenestrations in sinus wall. Both longitudinal and transverse striations take up the stain equally. The nuclei of the reticulo-endothelial cells of the sinus wall are at right angles to the cross striations. Section stained with logwood and van Gieson. $\times 1000$.
- Fig. 17.—Transverse striations in sinus wall. The nuclei of the reticulo-endothelial cells of the sinus wall are at right angles to these striations. Section impregnated with silver. $\times 1000$.
- Fig. 18.—Lightly-stained zones around malpighian corpuscles. Sinuses are situated some distance away from the corpuscle. $\times 23$.

PLATE IV.

- Fig. 19.—A zone of chicken's red blood corpuscles surrounds the malpighian corpuscles. The splenic artery was injected with these corpuscles. $\times 15$.
- Fig. 20.—Camera-lucida drawing. An ellipsoid with emerging capillary, which bifurcates, each branch opening into the peri-malpighian blood channel. $\times 223$.
- Fig. 21.—Camera-lucida drawing. Capillary leaving a malpighian corpuscle. One branch attains an ellipsoid, and the other opens at the periphery of the corpuscle. $\times 214$.

VIII.—STUDIES ON CELL DIVISION IN TISSUE CULTURE.

(a) THE EFFECT OF GAMMA RAY RADIATION ON CELL DIVISION IN TISSUE CULTURE *in Vitro*.

By R. G. CANTI, M.D., and F. G. SPEAR, M.B.,
From the Strangeways Research Laboratory, Cambridge.

(Read February 20, 1929.)

CERTAIN intensities of gamma ray radiation are known to cause diminution of the number of cells undergoing mitosis in tissue cultures. Further, if the source of radiation is removed, mitosis may return under certain conditions.

The experiment here described was carried out in order to determine the rate of reduction and of subsequent return of mitosis in tissue cultures. The material used was the choroid and sclerotic of the chick embryo grown in a hanging drop preparation of fowl plasma and chick embryo extract, incubated at 37° C. The source of radiation was 100 mg. of radium element in the form of sulphate, filtered with 0.5 mm. platinum.

Sets of four test cultures and four control cultures of the same batch were taken, and the test cultures exposed to the radium for $2\frac{1}{2}$ minutes at a distance of 0.5 cm. One set of cultures was fixed and stained immediately after irradiation, the second set was incubated for 35 minutes and then fixed, the third for 80 minutes, the fourth for 2 hours, and so on, the last set being incubated for 9 hours. Controls were fixed at the time of irradiation of corresponding specimens. The total number of cells in mitosis in each set was then counted and the number expressed as a percentage of that found in the controls.

The results thus obtained show that there is a rapid fall in the number of cells undergoing mitosis which reaches its lowest point (40 p.c.) in 80 minutes. After this period the numbers increase until the normal (100 p.c.) is reached in approximately $2\frac{1}{2}$ hours. This increase continues until the end of the fourth hour, when a maximum (160 p.c.) is reached. The numbers then again diminish and reach normal (100 p.c.) during the sixth hour of incubation, after which they remain constant. When these figures are plotted on a curve, it is seen that under the conditions of this experiment the diminution in the number of cells undergoing mitosis is compensated by a subsequent increase giving rise to a regular \cup -shaped curve.

(b) THE EFFECT OF LOW TEMPERATURE ON CELL DIVISION *in Vitro*.

By F. G. SPEAR, M.B.,

From the Strangeways Research Laboratory, Cambridge.

(Read February 20, 1929.)

The introduction of the technique of tissue culture has provided a method of studying the reactions of individual cells to various stimuli without involving the modification of behaviour consequent upon the action of nerve or blood-supply.

If cultures of the choroid and sclerotic of fowl embryos are put up in hanging drop preparations and examined, it is found that the number of cells undergoing mitosis at any particular moment is practically constant throughout the period from 18 to 40 hours after the second "sub-culture."

When cultures of this stage are exposed to a temperature of 0° C. for four hours and then incubated at 37° C., a fall is observed in the number of cells in mitosis till a minimum is reached after about 80 minutes incubation. The number of cells in mitosis in the chilled specimens is now 30 p.c. of that in corresponding controls. On further incubation recovery takes place; after 5½ hours incubation chilled specimens and controls appear alike. From this point, however, the chilled specimens show an increase in the number of mitotic figures above that in the controls, a maximum being reached after 8½ hours incubation, when the mitosis is 160 p.c. that of the controls. Mitosis then gradually falls off until specimens and controls are again alike. The fall in the number of cells in mitosis during the first 5½-hour period of incubation subsequent to chilling is almost exactly compensated by the increase which occurs during the second 5½-hour period.

(c) THE EFFECT OF X-RAYS ON MITOSIS IN TISSUE CULTURE *in Vitro*.

By S. F. COX, B.Sc.,

From the Strangeways Research Laboratory, Cambridge.

(Read February 20, 1929.)

X-rays may be considered one of the most effective agents for inhibiting mitotic division in cells. Previous experiments of Strangeways and Hopwood (1926) have shown that a rapid fall occurs in the number of mitotic figures in tissue cultures as the dose of X-rays is increased up to 10e (Friedrich's unit); that the fall is more gradual as the dose is extended to 60e.

This fact has been used to investigate two problems of X-ray dosage:

how far the biological effect induced by X-rays is dependent on (a) the intensity of the beam, and (b) the quality or wave-length of the beam. It is found that for a given dose of X-rays reduction of mitosis is more pronounced by irradiation with greater intensity over a short period of time than when the same dose is administered with smaller intensity over a longer period. Experiments with beams of different quality showed that a soft beam of long wave-length was more effective in inhibiting mitosis than a hard beam of short wave-length. The beams were compared by ionization methods.

Observations were made with dark-ground illumination on living cultures which had received doses of X-rays. The findings were confirmed by examination of fixed specimens. It was found that there was a latent period of about half an hour, subsequent to irradiation, during which the culture showed no visible abnormality. Degenerate and breaking-down cells then began to appear, but these gradually dissolved in the medium, and after six hours signs of degeneration were no longer appreciable. A dose of 100 e is necessary to produce these changes, and with larger doses the number of breaking-down cells is increased. It is only comparatively few cells that are destroyed in the manner described even when a very large dose is given. The mitochondria in the vast majority of cells remain healthy in appearance.

IX.—CONTRIBUTION TO THE DISCUSSION ON THE ABBE THEORY.

By J. W. GORDON, K.C.

(Read March 20, 1929.)

THE conclusions which Dr. Moore has drawn from premises that are very clearly stated in his paper (J.R.M.S., 1928, ser. iii, vol. xlviii, p. 133) appear to me to be so well established that I should have little to say on the subject were it not that his paper purports to give, on the authority of Prof. Berek, of Marburg, a very "complete history of the development of the problem and an excellent summary of the views expressed by different writers on the subject."

For such an account of the history of the discussion Prof. Berek must, I think, have made inadequate preparation, and in particular he seems to have overlooked almost completely the quite extensive discussion which is to be found in the English literature of the subject published in the early years of this century. Of that literature no inconsiderable part has appeared in the Journal of the Society, and it may perhaps be of special interest to the Society to have its attention drawn to important papers already published in its Proceedings in connection with Dr. Moore's further paper on the subject. I will therefore ask leave to add a few observations under this head to the historical summary of Dr. Moore's paper.

(1) The seventh and eighth editions of Carpenter's "Microscope and its Revelations" contain an important disclaimer by Prof. Abbe of the Abbe theory, which appears to have escaped the attention of Prof. Berek, presumably because it has only appeared in a book which, although well known, is published in English. On p. 64 of Carpenter's book an extract is given from a letter written by Prof. Abbe to the editor of those editions of the work, in which he says: "I no longer maintain in principle the distinction between the absorption image (or direct dioptrical image) and the diffraction image. . . . This distinction, which, in fact, I made in my first paper in 1873, arose from the limited experimental character of my first researches. . . . My views on this subject have undergone important modifications. Theoretical considerations have led me to the conclusion that there must always be the same conditions of delineation as long as objects are depicted by means of transmitted or reflected light, whether the objects are of coarse or very fine structure."

The whole passage—too long for citation here—taken in its entirety, is difficult of interpretation—indeed, to me, unintelligible—but it is not, on that account, an unimportant or negligible incident in the history of the discussion. The very explicit statements which I have here cited amount, taken by themselves, to nothing less than an abandonment of the Abbe theory by its author.

(2) Another work in which the Abbe theory was investigated and shown to be untenable, which appears to have escaped notice, is Sir Almroth Wright's "Principles of Microscopy," published by Constable & Co. in 1906.

(3) There is a reference in the bibliography, on p. 148 of Dr. Moore's paper, to Lord Rayleigh's paper in the Philosophical Magazine of August, 1896, on "The Theory of Optical Images." It will, no doubt, be convenient to members of the Society to be reminded that this paper was reprinted in the Society's Journal in 1903 (pp. 447-73).

(4) The above reprint is followed (pp. 474-82) by a supplementary paper by Lord Rayleigh, which was read at a meeting of the Society on the 17th June, 1903. This paper is of special importance in the history of the subject, because in it Lord Rayleigh shows that a dark line upon a bright field—the form which some of the smallest microscopic objects take, e.g., flagella—would be visible if its breadth did not fall short of $\frac{1}{2}$ of a wavelength of the light by which the field was illuminated. This paper so completely demolished the inference as to the limits of visibility in the microscope, for which Abbe contended, that his theory itself can no longer have any practical interest for either the makers or users of microscopes. That paper ought certainly not to be overlooked in a serious *résumé*, however cursory, of the literature of the subject.

(5) There is published (in the Society's Journal for 1904, pp. 385-7) a paper read on the 15th June in that year by Prof. J. D. Everett, entitled "A Direct Proof of Abbe's Theorems on the Microscopic Resolution of Gratings." In the discussion of that paper, which is reported in the same volume of the Journal (pp. 483-7), the direct proof was met with precisely the same arguments which are found in Dr. Moore's paper, and appear to have been advanced by Prof. Berek. These arguments were just as sound in 1904 as they are to-day, and, although the circumstance is of no great importance, it is of interest to recall that they have been before members of the R.M.S. for the last twenty-four years.

If I may be allowed to call attention to one of my own papers written on this subject so long ago as 1901, and published in the Society's Journal for that year, I should like to refer to an experiment described on pp. 365-8 of that volume. The experiment was made with the apparatus designed by Prof. Abbe and sold by Messrs. Zeiss to illustrate the Abbe theory, one slight modification only being introduced. With the Abbe diffraction plate as so furnished there was supplied an opaque disc furnished with a narrow slot to be mounted in the focus of the substage condenser for the purpose of furnishing a source of light of particular form at a particular

distance from the stage of the microscope. The result of using that source of illumination is that the object cannot be seen under the conditions of critical illumination which all microscopists employ when they desire to obtain fine resolution. To get over the obvious objection that observations limited to such an imperfect form of illumination could have no very direct bearing upon ordinary microscopic practice, I substituted for this immovable disc an optical equivalent in the form of an image formed in its place by a suitable post condenser lens of a larger disc having an aperture of the same shape, its image being reduced to the same dimensions as the Abbe disc. This image disc could be moved into any position nearer to or farther from the stage of the microscope, or even introduced upon the stage so as to realise the condition of critical illumination. When this substituted light source occupied the place of the Abbe disc, it exhibited all the phenomena which were supposed to establish the Abbe theory ; but when it was brought nearer to the stage of the microscope, the diffraction pattern was seen to change. The closer it got to the stage, the closer the diffraction images were forced together, and by adjusting its position you could obtain as many different images as you liked. But this presence or absence of diffraction rays makes no difference to the image of the object yielded by the objective, and when at last critical illumination was employed, it turned out that all the diffracted rays had blended with the dioptic ray, and no diffracted light at all entered into the image-forming beam.

This simple refutation of the Abbe theory has now been before the world for eight-and-twenty years. So far as I am aware, it has never been challenged. It appears to me now, as it did eight-and-twenty years ago, to be quite conclusive for anyone who will take the trouble to make the observation, and to anyone who entertains the idea that there may be some truth in the Abbe theory, I will ask permission to commend the making of the experiment and the study of its results.

MEMORANDUM TOUCHING PROF. SIEDENTOPF'S PAPER ON MERCURY GLOBULES.

In this paper Prof. Siedentopf discusses the measurement of mercury globules, and has observed that they appear larger when seen through objectives of wide angle than when seen through objectives of narrow angle, and he comes to the conclusion that the wide-angle lens gives the more correct measure of the diameter of the globule.

The question of the appearance of a mercury globule on the stage of the microscope formed the subject of a paper which was read at a meeting of the R.M.S. on the 20th November, 1907, and is printed in the volume of the Society's Proceedings for 1908 (pp. 6-19). The phenomenon which Prof. Siedentopf has observed is there described and discussed. The fact that objectives of wide angle give images of larger diameter than objectives of a

lower angle is shown to be due to the circumstance that the wide-angled objective enables the user of the microscope to see for a certain angular distance round the globule past its equator and so to examine the peripheral region of its lower face. This circular band of the lower face is seen projected on the stage of the microscope immediately surrounding the boundary of the upper face, and its inner—not its outer—edge affords the true measure of the diameter of the globule. It would seem, therefore, that Prof. Siedentopf is mistaken in supposing that the objective of wider angle affords the truer measure of the diameter of the mercury globule. The reverse is the case, or, to speak more accurately, the same measure will be given by wide-angled and narrow-angled lenses if the inner edge of the illuminated band is made the object of measurement.

It is shown in the paper of 1907 that the angular breadth of the illuminated circle so seen on the under-face of the mercury globule, if truly centred on the stage of the microscope, is equal to

$$a = \frac{1}{2} (u + u_1)$$

in which a = the angle subtended at the centre of the globule
 u = the semi aperture angle of the objective
 u_1 = the semi aperture angle of the condenser beam

It is manifest from this formula that the condenser angle ($2u_1$) remaining constant, the angle (a), and consequently the false addition to the apparent breadth of the mercury globule, must be greater when the aperture of the objective ($2u$) is large than when it is small. Consequently, the objective of smaller angle will introduce less error than the objective of greater angle if the measurement is taken—as Prof. Siedentopf's measurements are—to the outer edge of the image.

X.—NOTES ON THE ABBE THEORY.

By CONRAD BECK, C.B.E., F.R.M.S.

(Read March 20, 1929.)

My own view of the Abbe theory is that it is an unusually interesting diffraction experiment which has no practical application to microscopic resolution. This can be better discussed by those who follow me, but the correctness of the Abbe theory is *not* merely of *academic* interest. Certain important practical matters are directly dependent on its validity.

The logical deduction from its acceptance is that the best method of illuminating high-power microscopes is either by a single beam of parallel light on the axis or two parallel beams at such angles as to enter extreme margins of object-glass. To provide for this, all German substage condensers were made at the time with a wide-angle almost uncorrected set of lenses, below which there was provided a pinhole or slit diaphragm that could be accurately racked backwards and forwards so as to deliver upon the object a small, almost parallel, beam of light at any desired angle. The Abbe condenser was the name for this combination of condenser and movable stops. The term has since been used to describe a large wide-angle uncorrected condenser with or without such adjustable stops, although such condensers without the stop adjustment were in constant use long before.

Microscopists in this country did not practise this form of illumination. Mr. E. M. Nelson convinced them of the desirability of the use of a wide-angle cone of light. The adjustment has survived on many foreign instruments, its only other use being for testing the correction of the zones of an object-glass.

This suggested method of illumination can scarcely be said to have hindered the design of the microscope, as in practice it was very little used, but a more important consideration follows from the Abbe theory. It was supposed that the outer zones of the object-glass formed the image of the fine details of the object, while the so-called macroscopic image was formed by the centre, and I am of opinion, from examination of some of the lenses made at the time, that it must have been considered that if the outer zones were corrected in themselves, it was not of great consequence if they did not focus to the same point as the central zones.

Fortunately, practical experience prevented this method of manufacture being adopted to any great extent, and it was soon found of the utmost importance that all the zones of a wide-angle lens should focus to the same point.

The serious effect of the Abbe theory was that it prevented sufficient attention being devoted to studying the question as to whether the illumination utilised the aperture of the object-glass in a satisfactory manner. Abbe showed, in his elegant experiments, how, by altering the shape of the aperture by putting stops of definite shapes behind the object-glass, images could be formed that did not resemble the object. He discussed these in connection with his theory, but the fact that by bad illumination distorted or incorrect images can be produced seems to have been overlooked. If the illumination is such that a fine slit of light only passes through the object-glass, the results will tend to be the same as if an actual slit were placed behind the object-glass. Bad illumination may spoil the performance of the best lens, and this question has been obscured by the belief that the object was being depicted by a characteristic diffraction effect due to the object itself.

Another curious point has been deduced from the Abbe theory, namely, that dark-ground illumination could not give nearly the maximum resolving power of an object-glass. If this had been acted upon, it might have prevented the greatest advance in high-power examination of living organisms that has been made, and which I think we may say is chiefly due to our President.

Dr. Siedentopf, as recently as June, 1928, in the *Zeitschrift für Physik*, considers that I am wrong in stating that microscopic resolution with dark-ground illumination is the same as that with transmitted illumination.

I have described two experiments to illustrate the fact. He makes no comment on one of them, but, as regards the other, he considers that I am under a delusion in stating that the resolution of *Amphipleura pellucida* into lines at right angles to its length can be obtained with an aperture of $\cdot 95$ N.A. with dark-ground illumination, but that it is due to interference lines caused by diffraction images of the broken edge of a diatom. I am familiar with this effect, but the cross lines to which I refer are shown along the entire length of an unbroken diatom. They are very faint with an aperture of $\cdot 95$ N.A., very clear with an aperture of $1\cdot 2$ N.A., and with an aperture of $1\cdot 4$ N.A. the whole structure is shown as distinct dots. The illumination is a complete hollow cone of light, the minimum angle of which is slightly more than the N.A. of object-glass used, and the cone of light is very accurately centred. The diatom is mounted in realgar in order that it should give by reflection adequate light. The resolution is not due to interference images of the edge of the diatom. These are also to be seen in the cases of broken diatoms near the broken edges, together with the Moire effects where diatoms are superposed, but can be clearly distinguished from the true resolution. With transmitted light and between crossed Nicol prisms approximately the same results are obtained, and in both cases are on the theoretical limit of resolution.

Thus it should, I think, be appreciated that the discussion of this theory is of the utmost importance to the practical as well as the theoretical microscopist.

XL.—CONTRIBUTION TO THE DISCUSSION ON THE FORMATION OF THE MICROSCOPICAL IMAGE.

By INSTRUCTOR-CAPTAIN M. A. AINSLIE, R.N.

(*Read March 20, 1929.*)

I FEEL rather that I am in the position known as "sitting on the fence" as regards the two theories. I do not quite like either of them. The original Abbe theory of the narrow illuminating beam, etc., does not appeal to me, and although I should like to accept the "equivalence" theory, I find some difficulty in doing so. There are some papers, by Prof. Conrady, published in the Society's Journal in 1904 and 1905, which have not so far been mentioned in this discussion, but which are important in many respects. In particular, Prof. Conrady shows that the objection often urged against the Abbe theory, that the image formed by the mutual interference of the diffraction spectra (formed by the structure of the object) should be *non-focal*, disappears when a "large cone" is employed, since the various diffraction patterns formed in the tube can only coincide in the plane of the geometrical focus, where they form a distinct and easily focused image which is, as far as it goes, a faithful representation of the object.

But the greatest difficulty in regard to the "object-diffraction" theory—if I may use this term for the extension of the Abbé theory to include the use of large illuminating cones, according to present-day practice—seems to be that it will not account for resolution *on a dark ground*. But does the equivalence theory do so? Consider the case of *P. angulatum*, which Mr. Beck is showing to-night, resolved on a dark ground with an objective of 0.65 N.A. This, as it happens, is one of the few cases where the Abbe theory gives a reasonable explanation. For suppose that the specimen is so placed on the stage that the striæ, or rows of dots, lie in the directions XII, IV, and VIII. Suppose, further, that we reduce the annulus of light outside the margin of the objective to a small beam coming from the direction XII. On the equivalence theory we should expect, if every "dot" in the object is to shine like a self-luminous object, that the general illumination would be reduced, but that each dot would receive light and therefore be separately visible, the N.A. of the objective being in this case more than sufficient.

If there is any preference, we might expect the rows (or lines) IV and VIII to be more strongly shown than those in the direction XII, as receiving

the light "broadside on." But, as a matter of fact, we only get the lines in the direction XII. Now remove the eyepiece and look at the back lens of the objective. We see, of course, no direct beam, but we do see two first-order diffraction spectra, and these are formed by the striæ IV and VIII. They lie along the line III—IX, and their interference produces the appearance in the image of the lines in the direction XII. When the full annulus is restored, we have each set of lines imaged by the interference between the spectra due to the other two sets, and the intersection of these three sets of bright lines gives us the familiar "dotted" appearance. This, however, is a special case, and in general I do not regard the "object-diffraction" theory as giving at all an adequate explanation of dark-ground resolution. Further, it is perhaps worth while mentioning that when the width of the slits of a grating is equal to that of the dark spaces, the second-order spectrum is suppressed (by the interference of light from the different parts of each slit), and we only have the first-order spectrum present, which, according to this theory, is not by itself sufficient to give resolution.

We are sometimes told, by the opponents of the "object-diffraction" theory, that when we use a large cone of illumination, or an extended source of light, which comes to the same thing, the diffraction spectra are "abolished." As we increase the cone of illumination, the spectra overlap the direct cone more and more, and may become invisible—in fact, must do so when the aperture of the objective is completely filled; but they do not cease to exist, and are still playing their part, so that their apparent disappearance cannot, I think, be taken as in any way weakening the position of the theory. And as to the question of coherent or non-coherent light falling on the object, I think we must endeavour to explain our images without too much stress on this point. Consider our usual methods of illumination. Sometimes we focus on the object the image of a luminous surface, sometimes that of the aperture of a diaphragm, in which case the edge of the aperture is all that is focused, and not the light at all; sometimes, as in the case of the old "flame-edge," that of a luminous object having considerable depth, in which case probably at least 90 p.c. of the light is not focused on the object at all. Photo-micrographers will appreciate this point. Such being the case, sometimes we may be using an approximation to non-coherent light, but more often the light will be coherent, and capable of producing diffraction spectra by the action of the object. And yet, so long as the objective is properly filled with light, and other necessary adjustments attended to, we get identical images in every case.

But the most serious objection, to my mind, is illustrated by the three slides I am showing. These are all photographs of *P. angulatum*, taken with a dry 6 mm. objective (Watson Holo.) of N.A. 0.83 and an illuminating cone of N.A. 0.75. The first is taken with the tube length at its correct value, and you see that the "dots" and the coarser features, including the "postage stamp" at the broken edge, are shown *at the same focus*, as they should be, since they all lie in the same plane. The second slide shows

the result of altering the tube length by less than an inch—20 mm., to be exact—and you see that when we focus on the coarser details, the dots have almost disappeared, while, as seen in the third slide, if the dots are focused, the coarser details are quite out of focus. Now, if we adopt the “equivalence” theory, and take every detail of the object as acting as an independent source of light, we should expect the introduction of spherical aberration by incorrect tube length to impair the definition of all details to the same extent—there would be general fuzziness, and we should not obtain a sharp image of any of them at any focus—but you see from the slides that at one focus, that of the central portion of the objective, you get the outline sharply defined, and at the other focus, that of the marginal zone of the objective, the finer details are well shown. This can only mean that the fine details are imaged by the marginal zones, through which the diffraction spectra due to them pass, while the less deviated spectra due to the coarser details pass through the central portion of the objective, and are imaged at its focus.

There is just one other point which may (or may not) be of some importance. The limit of resolution, according to the equivalence theory, is $0.61 \lambda/A$; according to the object-diffraction theory, $0.5 \lambda/A$. * The latter is exact; the former depends on the assumption that the “spurious disc” of the image of a luminous point is half the diameter of the first dark ring of the diffraction pattern. This estimate is, at the best, a rough average; the actual value depends on the intensity of the light emitted by the object. If we adopt the equivalence theory, it is legitimate to draw inferences from the appearance of stars as seen with telescopes, and it is well known that diameter of the apparent visual image of a star as seen in a telescope varies considerably with its brightness. Is the same effect observed in the case of luminous points seen with the microscope?

I do not think that the two theories are mutually destructive, but I do not think that either of them, *by itself*, affords a complete explanation of the observed facts. What we want is, I think, a simple theory which will explain *everything*.

XII.—THE MODE OF FORMATION OF THE IMAGE IN THE MICROSCOPE.

By JULIUS RHEINBERG, F.Inst.P., F.R.M.S., F.R.P.S.

(Read March 20, 1929.)

ABSTRACT.

It is shown that, as regards the formation of the image by the microscope, the Abbe theory and the Airy theory and its variants do not in any way conflict. The Abbe theory, by reason of the way it originated, deals in the first place with objects so illuminated as to lack self-luminosity to the maximum extent. The Airy theory deals with completely self-luminous objects. These are the two limiting cases. A gradual but strictly limited approach towards self-luminosity is presented by the structural elements of objects according to the way they may be illuminated. It is indicated how all cases can be, and are, indeed, most conveniently dealt with by the Abbe theory.

The chief fallacies underlying the various objections to the Abbe theory are discussed, and suggestions made to account for results obtained with dark-ground illumination, which have been held to be at variance with that theory.

Dr. Moore has given us a very fair summary of the controversies which have taken place since just over fifty years on this subject,* and which have of late years again been renewed.

That they should have been renewed on the lines they have is the more remarkable, as it appears to me that the theory of resolution by the telescope of luminous objects, as worked out by Airy, Rayleigh, and others, does not clash at all with the theory of the resolution of non-luminous objects as worked out by Abbe in his so-called "diffraction" theory.

It is, of course, necessary to sharply distinguish between such theories themselves and any false deductions or assumptions that have been made from time to time by the authors, adherents, or opponents of the theories, but a false deduction from a theory does not upset a theory itself unless the actual fact cannot be harmonised with the theory.

* "The Mode of Formation of the Image in the Microscope," H. Moore, J. Roy. Micro. Soc., 1928., vol. xlviii., pp. 133-43.

Before attempting in a most general way to show how the theories may be harmonised, and how such false deductions easily arise, may I illustrate this by two examples, the first of which I will draw from Dr. Moore's paper? He introduces us to what, for the sake of convenience in discussion, he terms the "equivalence" theory, concerning which he says: "Up to the time when Abbe put forward his diffraction theory of microscopic vision, it was generally accepted that the images of non-luminous objects were formed by processes essentially similar to those involved in the formation of images of self-luminous objects." . . . "As regards the image in the microscope, the microscope object-glass was considered to act exactly as any other kind of lens, and such relations as that connecting resolving power with aperture were assumed to be the same for microscope object-glasses as for telescope object-glasses and lenses of all other kinds."

Now, if the words "by processes essentially similar" mean what they may be supposed to mean, viz., "in accordance with the wave theory of light," these facts hold good, *whatever* theory of image formation in the microscope we choose to select. But sandwiched in between the above sentences we find: "A non-luminous object was, in fact, considered as exactly 'equivalent to a self-luminous object.'" There we have a false deduction which does not follow at all from the above so far as resolution by optical instruments is concerned, and Dr. Moore shows that he knows that this is a *non sequitur* by mentioning, after pointing out that these views were expressed by leading physicists of the day, that the theory was never proved or even stated in any explicit manner.

My second illustration is drawn from the adherents of the Abbe "diffraction" theory. It is a matter of history that after Abbe had, in 1877, elucidated his epoch-making theory, proving it by his work on gratings, with illumination by parallel beams of light, his adherents advocated narrow cones of light for illumination with the microscope, and that, more than to anyone else, we owe the use of wide-angled cones of illumination, now admitted as more correct by all parties, to the efforts and demonstrations of our former President, E. M. Nelson. But the use of narrow-angled cones of light by no means followed from the Abbe theory—it was simply a false deduction—and Nelson's attack on the theory itself was not warranted, except in so far as it had given rise to this false deduction, the reasons for which cannot be better or more succinctly expressed than Dr. Moore has done in his paper,

To me it appears that the main cause of the antagonism between those advocating one theory or another arises from the fact that they either overlook a few fundamental principles, or that they draw conclusions from experimental results without sufficient check on the conditions of the experiment.

What, after all, is the basic principle of image formation in *any* optical instrument? Put in simple language, it surely is that the rays of light originating from a point of the object arrive at the image plane after passage

through the lens system in some phase relationship, so that, in accordance with the wave theory, they "interfere" with one another and thereby cause a certain degree of lightness or darkness, presenting resemblance to the object point from which they originated. Light vibrations arriving at points of the image plane in a condition to interfere with each other—so-called "coherent" light—are therefore of the essence of the image produced by any optical instrument.

What is the fundamental difference between a luminous and a non-luminous object? In the case of the light proceeding from a point of a luminous source, all the rays spread out regularly therefrom in *all* directions in phase relationship, and, given a perfect lens system, they arrive at the image plane in phase relationship or "coherence," and the diffraction disc representing the image of such a point is determined by the diffraction caused by the aperture of the lens system alone. The resolving power of the telescope for stars as worked out by Airy, Rayleigh, etc., is based upon this.

In the case, however, of a non-luminous object we can only obtain an image of its separate parts or points by means of the light which has impinged on those parts or points from an extraneous luminous source. And now we no longer have coherent light rays spreading out regularly from points of the object in all directions, for the object itself diffracts the light; in other words, a narrow beam of light passing the object is spread out fanwise, the light rays proceeding in various definite directions and intensities according to the well-known laws of diffraction.

Consequently, when the image of a non-luminous object is produced by a lens system, whether it be the terrestrial telescope, the field-glass, the camera or the microscope, the action of these diffracted rays, as well as the aperture of the lens system, has to be taken into account in questions concerning resolving power.

We owe it to Abbe to have shown *how* this light diffracted by the object has to be taken into account, so far as it concerns the quality of the image and the resolving power of the microscope. His results, never yet disproved, show that the more of these coherent *diffracted* light rays from any object point come together again after passage through the lens system in the image plane, the better the quality of the resulting image will be, and that unless at least two of them arrive there, i.e. either the central direct ray and one diffracted ray, or two diffracted rays, there will be nothing which can be termed an image at all.

It may here be noted that as the limit of resolving power of a telescope lens is determined by the diffraction caused by the aperture of the lens system, and as the conditions for the maximum resolution of objects seen by the microscope are that diffracted rays which just fall within the aperture of the lens system are picked up, it requires no special reasoning or mathematics to see that the resolving power is governed by the same formulæ, however obtained, and, in fact, Airy, Rayleigh, and Abbe all arrive at the same substantial result. There is no divergence here.

Also it may here be noted that it is only in the case of such minute structures as are observed with the microscope that light can be seen to be diffracted into such wide fans that the diffracted beams only just fall within the grasp of the objective aperture. Where structure is coarse, the diffraction fans are correspondingly contracted and fall within a smaller part of the objective aperture, so that they play no such important part in the field-glass or camera, although just the same laws apply, as I have formerly tested with telescopes and objects of quite large size. Sir Herbert Jackson's remark, referred to by Dr. Moore (p. 142), certainly holds good, and again we find no antagonism between the various theories.

We may now usefully recall how the Abbe theory came about. An excellent account of this is given by Conrady in his article on "The Optics of the Microscope," in vol. iv of the Dictionary of Applied Physics, but I would put it in the following way. Abbe found that the Airy theory afforded no sufficient clue to resolving power and to a number of other problems, so far as the microscope was concerned. To investigate resolving power, he would *naturally* experiment with objects of known structure, as simple as possible, and, in fact, he worked largely with fairly coarse gratings ruled in a silver film. He would also, as a matter of course, restrict the size of his light source for such investigations, so that light falling on the object might be coherent and capable of interference. This mode of investigation led to his observing the diffraction spectra in the back focal plane of the objective, and he was able to show how the distribution of these spectra influenced the appearance of the image of the object and their relation to the resolving power of the microscope. If we bear this in mind, it affords at once the clue as to Abbe's presentment of the "diffraction" theory, and it affords the clue as to how the deduction arose that the theory applied particularly to objects viewed by narrow illuminating cones, which in its turn led advocates of the theory to turn to incorrect modes of illumination, and the advocates of wide-angled cones of illumination to denounce the theory.

Next let us try and see why the Abbe theory holds good, and why, whilst it certainly conflicts with the idea of an "equivalence" theory, it does not conflict with the established theories of Airy or Rayleigh. To do so we must revert to the illumination of non-luminous objects, and for the moment we may consider a grating or other object with periodic structure, such as a diatom.

If we view this by *parallel* light from the condenser emanating from a single-point source, then every point of the object will receive coherent light capable of interference, and as the structure of the object diffracts the light, images of the light source, i.e. the well-known central and diffracted images, would be seen in the back focal plane of the objective. A single-point source is, of course, an abstraction, and in practice we use a more or less extended light source. Provided we retain the parallel light, this merely means that the central and diffracted images are likewise extended, but as no *interference* results from rays coming from different points of the light source because these are non-coherent, the only difference is that we can

now see the central and diffraction images better in the back focal plane of the objective, whilst the nature of final image in the image plane of the microscope is not affected. It is brighter because it is a summation of the images which would have arisen from every single point of the light source.

I mention this because it applies equally to convergent light from extended light sources, and shows that we need only focus our attention at present on light emanating from a single point of the light source.

If by means of the condenser we cause the *coherent* rays from such a single point to *converge* on an object element, as we do when we use our condenser in the ordinary way and focus the light on to the object, then interference at the object point *does* take place, and as I have shown in the simplest manner in a paper entitled "The Common Basis of the Theories of Microscopic Vision Treated Without the Aid of Mathematical Formulæ," published in 1902 in the "Zeitschrift für Wissenschaftliche Mikroskopie," vol. ix, the greater the cone of illumination, the more does the object element *approximate* to being self-luminous.

If it were possible for an object element to be illuminated with coherent light rays from *every* direction, then that object would be equivalent to being self-luminous; but as we can only use illuminating cones of a certain angle, we can at best get but a poor approximation, and it is just owing to this want of equivalence to self-luminosity that the Abbe diffraction theory is so helpful, and enables us to determine what we are doing and to interpret our results.

To take a few practical examples. Microscopists know very well that however perfect their objectives, they cannot illuminate with a full cone of light as wide as the objective aperture will permit without losing in definition. No theory but the Abbe theory will adequately explain that fact, but *that* theory, by showing how we are simply superimposing on relatively good images of object elements more imperfect images of these, which are yielded by the light of the outer annulus of the illuminating cone, affords an adequate and often an easily checked result. The reason for the latter images being more imperfect is because certain of the beams diffracted by the object elements do not then enter the objective.

Again, Airy's theory by itself quite fails to explain many problems in dark-ground illumination. It is quite possible to examine gratings of known pitch and under the same conditions of illumination to be able to resolve certain of the finer ones, whilst certain of the coarser ones are not resolved. Under perfectly normal conditions we may also see periodic structure doubled, by dark-ground illumination, as I have experimentally demonstrated. These effects can be accounted for by the Abbe theory, but by no other. It is not necessary to enter into detailed explanations here. They may be found by examining the papers at foot.*

* Conrady.—"Theories of Microscopical Vision," J. Roy. Micr. Soc., 1905.

Rheinberg.—"On the Influence on Images of Gratings of Phase Differences Amongst their Spectra," J. Roy. Micr. Soc., 1904, 1905, and 1906.

As all the theories of microscopic vision put forward really resolve themselves, however they may be called, into slight variants of the Airy theory and the Abbe theory, my general conclusions harmonising these, but rejecting the "equivalence" theory (which may have been tacitly assumed, but has never been explicitly stated), may now be given. They are as follows :—

The Airy theory gives the limit of resolution for self-luminous points in any optical instrument.

Illuminated points in objects having structure never behave as self-luminous points; they cannot, under the conditions of illumination with the microscope, attain to anything approaching self-luminosity, but they do up to a certain extent proceed in the direction of self-luminosity, according to the extent to which a solid illuminating cone from the condenser focuses a point of the light source on to the image elements.

The Abbe theory yields the solution as regards the definition and the resolving power of the microscope in regard to structure not completely self-luminous; it was deduced and presented in its limiting form of solving problems of resolving power where the illumination is such as to present the maximum absence of self-luminosity, but it applies equally well to all degrees of want of self-luminosity, and therefore solves those problems which the Airy theory is incapable of explaining. The maximum resolving power with a given objective follows alike from both theories, although the Abbe theory shows that this may be attained without the objective being completely filled with light.

Being aware of the nature of criticisms likely to arise from the above statement by those who have latterly been obtaining results which they believe are inexplicable by the Abbe theory, I will now proceed to deal with some of these.

In the first place, it is likely to be said that resolving power in connection with gratings is one matter, whereas resolution or definition of an object having no periodic structure is another. Well, when questions of resolving power are concerned, the minimum number of lines or elements we can talk about are two—just as the astronomer talks of the separation of double stars. This matter was investigated by Dr. Johnstone Stoney somewhere about the year 1894. He actually discovered that under certain conditions of illumination two isolated lines could be resolved by the microscope with an objective of smaller N.A. than would be needful to resolve a large number of lines spaced similarly apart—a matter which incidentally proved that under those conditions of illumination one part of the object could influence the images of other parts. I had the privilege of seeing Dr. Stoney's experiments, and repeated and demonstrated them in a modified form later on. In my paper "An Overlooked Point

Concerning the Resolving Power of the Microscope" (Journal Quekett Microscopical Club, 1904, p. 21) a full description and explanation are given. By the Abbe theory the result is explained with great ease. Lord Rayleigh, with whom Dr. Stoney had discussed the matter, was also able to prove it by recourse to other methods of treatment, which Dr. Stoney regarded as "a great achievement."

Now let us consider object elements having no periodic structure at all—for example, the edge of an opaque object. Naturally we cannot here speak of resolving power, but only of definition. The edges of the object will, of course, diffract light, and according to the extent to which the chief diffraction maxima are picked up by the objective, so shall we obtain a better or worse defined image. My purpose here is only just to indicate how the Abbe theory is capable of dealing with such objects as well as those having periodic structure.

A second kind of criticism which has appeared of recent years seems to be based upon a misconception of elementary physical laws. M. Berek in Germany and C. Beck in this country seem to be under the impression that because the nature of the image in the image plane can be deduced from the nature and distribution of the spectra in the back focal plane of the objective, when these can be seen there, therefore when they are not visible, and we apparently get more or less even illumination in the back focal plane, then such deductions no longer hold good, and image formation proceeds in a different way. It is, of course, easy enough to conceal spectra in the back focal plane of the objective. We can increase the illuminating cone. We can extend the light source. We can even introduce any amount of glare, on the combating of which for a long time somewhat neglected source of trouble no one has done more good work than Beck. But we cannot annihilate the wave motion proceeding from points in the back focal plane of the objective towards the image plane, whether we superimpose at those points other waves which are coherent or which are non-coherent. Because it happens to be the case that the wave motion in the image plane, as represented by lightness and darkness, can be conveniently deduced by reference to the wave motion in the back focal plane as represented by spectra which can be seen when we can arrange to disentangle the light there, the wave motion is not stopped because the spectra happen to be concealed from our eyes. On the contrary, we know that wave motion proceeds from place to place in an orderly fashion, whatever other wave motion may be superimposed on it.

The confusion of ideas underlying the fallacy in question is possibly realised still more when we reflect that any single point in the image plane is not referred back to or represented by any single point in the back focal plane of the objective, but to light or wave motion distributed over the whole of the back focal plane. And a point may here be added to which little attention seems to have been given, viz., that when we do see spectra in the back focal plane of the objective, these spectra are not due to any

single element or point of the object—they would be much too feeble to observe if that were the case—they are due to the combined action in that particular plane of objects having periodic structure, and become visible on that account. Because such spectra may be visible in that plane, we are not prevented from seeing irregularities in the object structure, say, of a diatom, or gaps, or different lengths of lines in a grating we may be viewing. This in itself shows that *each individual element of the object structure plays its own part in regard to its own image formation in the image plane*, although we may have only been able to gauge the degree of verisimilitude of the image to the object element by means of the spectra seen in the back focal plane of the objective, which are neither more nor less than a mass effect in that plane, owing to the object having periodic structure.

Incidentally we see here again why objects having periodic structure were requisite in the first place to elucidate the laws of image formation in the microscope.

It remains to discuss a more important set of criticisms purporting to show that the Abbe theory must be wrong. These are based on the fact that Beck and others think they have resolved structure by dark-ground illumination, which, according to the Abbe theory, could not be resolved in this way. As Dr. Moore points out, Beck makes the statement in his book on the microscope that "anything that can be resolved by transmitted illumination can be resolved by dark-ground illumination," * and instances the resolution of *Pleurosigma angulatum*, which is supposed to have 44,000–49,000 dots or lines per inch with an objective of N.A. $\cdot 5$, and of *Amphipleura pellucida*, which is supposed to have 92,000–95,000 dots or lines per inch with an oil immersion objective of N.A. $\cdot 95$ and a 1.3 N.A. condenser. Now, Conrady has, in his article in the Dictionary of Applied Physics, vol. iv, p. 36, clearly set out the general limit of resolution according to the Abbe theory, showing that when regular structure is illuminated by rays so oblique that the direct light does not enter the objective, the image can only be formed by the diffracted light, and that as at least two diffraction spectra are necessary to secure an image of the structure, an illuminating cone three times the N.A. of the objective is necessary in order that two diffracted spectra may be picked up by the opposite margins of the objective, and allow the latter to depict as much structure as it could by transmitted light. As, however, no illuminating cone can exceed an aperture of 1.5 N.A., the full resolving power of objectives exceeding $\cdot 5$ N.A. cannot be realised by dark-ground illumination.

This manifestly conflicts with the supposed results obtained, and it is necessary to seek for explanations. Siedentopf, in a recent and most interesting paper, "Ueber die optische Abbildung von Nicht-Selbstleuchttern," † dealing generally with the same problems as this discussion does,

* "The Microscope," Part II, by Conrad Beck, p. 125.

† Zeitschrift für Physik, 1928, pp. 297–309.

has made a series of careful experiments with *Amphipleura pellucida* under dark-ground and ordinary illumination, which he illustrates by photographs, and arrives at the result that Beck's images are due to spurious diffraction effects. However, that by itself does not clear up how an objective of $\cdot 95$ N.A. could show any resolution at all, whether spurious or otherwise, of structure in the neighbourhood of 90,000 lines per inch when the illuminating annulus of light lies between $\cdot 95$ N.A. and $1\cdot 3$ N.A., i.e. when the condenser N.A. is scarcely $1\frac{1}{2}$ times the objective N.A. instead of the 3 times referred to by Conrady. We may perhaps here bear in mind that Abbe himself did not deal with the way in which his theory applied to dark-ground illumination. According to Neuhaus,* cited by Siedentopf, dark-ground illumination was at that period regarded more in the light of an interesting amusement than as being of practical value. It seems evident to me that Conrady, in dealing with dark-ground illumination, lays down the rule as it would apply to gratings in a film of no sensible thickness—he postulates that no direct light enters the objective, but only diffracted light. Now, it is common knowledge that those objects which are best seen by dark-ground illumination are those which *refract* light more or less strongly—diatoms afford an excellent example—and refraction regarded in terms of the wave theory simply means that the direct beam of light impinging on elements of the structure (as well as the diffracted beams) gets shifted in its direction. Not only does it seem reasonable to assume, therefore, that in the case of diatoms the direction of the light which impinges on them from the condenser annulus of light may be refracted or shifted, and that the central maximum enters the objective, but it would almost appear unreasonable to assume the reverse, i.e. that *only* diffracted light enters the objective in such cases. If, however, that be so, then there is no reason why in special cases the same resolution should not be obtained as by ordinary transmitted light, and the seeming conflict with the Abbe theory is removed. In a paper "On Resolutions Obtained with Dark-Ground Illumination and their Relations to the Abbe Theory," Quekett Microscopical Club, vol. xi, pp. 501-6, I dealt at some length with this aspect of the subject.

Another patent example, where any rule applied to ordinary gratings would not apply, is afforded by the so-called "saw-edge gratings," as originally devised by Rayleigh, I believe, and which have been produced by Thorpe and the successor of Grayson of Melbourne. These gratings are so formed as to be equivalent to a series of diminutive prisms lying next to one another, with the result that transmitted light impinging on them is refracted according to the angles of the prisms. Manifestly this is a case where direct light as well as diffraction spectra could be caused to enter the objective under dark-ground illumination, although the N.A. of the illuminating annulus did not greatly exceed the N.A. of the objective.

The above examples may serve to show that the nature of the image

* R. Neuhaus : Lehrbuch der Mikrophotographie, 1898.

with dark-ground illumination will depend, even more than with illumination in the ordinary way, on the nature of the object itself, and consequently it is not feasible to refute a theory by results obtained with objects whose structure is not completely known. To prove the Abbe theory to be wrong, it will be necessary for its opponents to devise experiments with artificial objects of known structure.

The utility of the Abbe theory in regard to image formation cannot perhaps find a better example than in the warning it gives us as to the limitations of dark-ground illumination, which, owing to the advantages of one being able to see images with greater ease, comfort and brilliance, is coming increasingly into use. We know from its teachings that to obtain a good definition of an object element, one direct beam and several beams diffracted by the object must enter the objective. Next best to this is one direct beam and one diffracted beam; somewhat worse than this, because it alters light intensities, two diffracted beams only; and worst of all, because it yields no image and only superfluous glare, one direct beam or one diffracted beam. With dark-ground illumination, although we may under somewhat exceptional conditions be able to secure for the finer as well as the coarser structure the above desiderata for good definition, in general the conditions are such as to directly lead to the worse kinds of images of the finer structure or the suppression of the image of the finer structure.

Looked at in another manner, from general considerations, the same result follows. All will admit that *if* illuminated points behaved as self-luminous points, so that the Airy theory could be applied, we would get the maximum resolving power. If illuminated object elements, however, only approximate to self-luminous points according to the degree to which coherent light impinges on them from every direction, then it follows that when such light can only impinge on them from the narrow annulus by which the N.A. of the illuminating cone exceeds that of the objective, these elements are less likely to behave in regard to their image formation as if they were self-luminous points than when they are illuminated by a solid illuminating cone of the approximate N.A. of the objective. This, I am aware, is a somewhat loose form of argument, but I am only concerned here with trying to explain the general trend of the reasoning. To work out the results in individual cases requires not only an exact knowledge of the particular optical conditions, but also a general knowledge of the nature of the object, the dimensions of its structural elements, their approximate refractive index, and so on.

Under one set of circumstances images as worked out by the Abbe theory and the Airy theory yield practically the same result. This occurs where elements are so small as to be only a relatively small fraction of the wavelength of the light with which they are viewed. From such elements, e.g. colloidal particles or sufficiently minute holes in opaque films, the light impinging on them spreads out in all directions without a first diffraction maximum being formed. Consequently such illuminated objects actually

behave as if they were self-luminous, except that the intensity of the light is not quite equal in every direction. But as the first diffraction maximum is missing, so also is definition missing in the image, which presents the appearance of the well-known spurious disc determined by the aperture of the objective. This is a limiting example which again shows how there is no conflict between the Airy and Abbe theories.

The conception that illuminated points of an object may, without acting like self-luminous points, yet approach to this in some degree has been gaining ground for some time, and von Laue, in a paper on the theory of optical image formation in 1914,* held that the images of self-luminous and illuminated points were complementary under certain conditions, of which a chief one was that of illumination from every direction. Siedentopf, in his paper before-cited.† develops this further by pointing out that as objectives only have a limited angle of aperture, whereas the above theorem postulates an angular aperture of 360° , certain considerations have to be taken into account, and he states his results in a simple mathematical formula, which he discusses, and for which readers are referred to his paper.

With Siedentopf's main conclusions that the Abbe theory alone enables us to interpret with full justice the images of non-luminous objects, even when wide illumination cones are employed, I find myself in complete agreement.

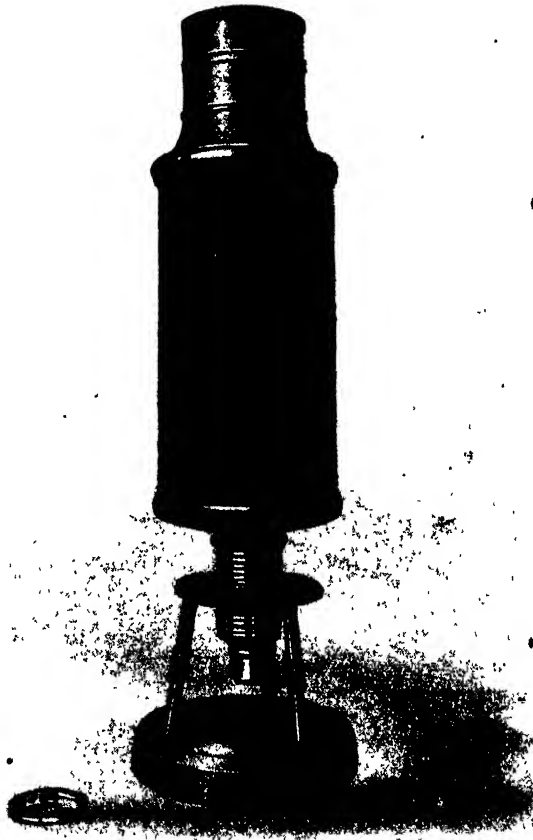
* "Zur Theorie der optischen Abbildung." *Annalen der Physik* 43, pp. 165-8.

† "Ueber die optische Abbildung von Nicht-Selbstleuchtern." *Zeitschrift für Physik*, 1928.

XIII.—DESCRIPTION OF 17TH-CENTURY MICROSCOPE.

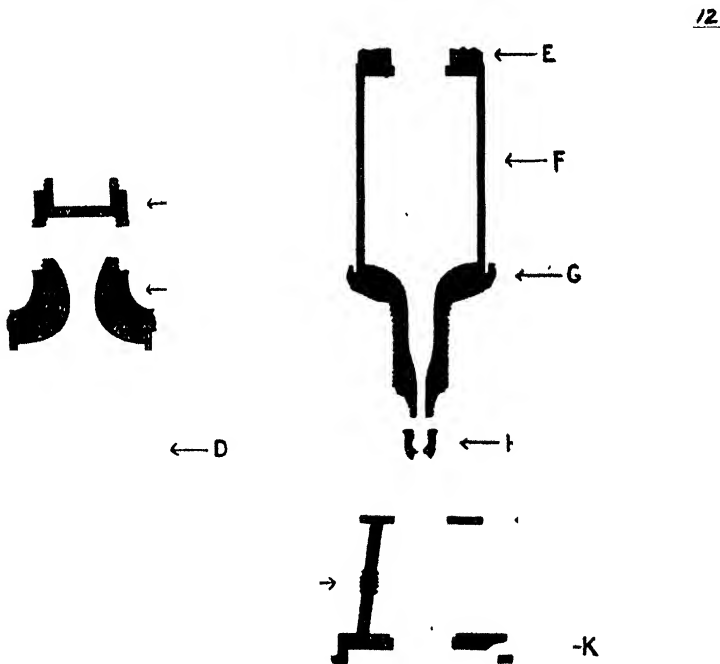
By CHARLES BECKE, F.R.M.S.

THIS microscope was made in the middle of the 17th century, and consists in the main of leather, vellum, and lignum vitæ. The three pillars are of brass, and the circular plate through which the nosepiece screws is of



horn. The lignum vitæ appears to have lost a good deal of its weight through age. Referring to the diagram, A is a cap, $1\frac{1}{8}$ in. in diameter and $\frac{7}{8}$ in. deep, which screws on to a second cap, B, $\frac{3}{4}$ in. deep, forming a box which contains an objective mount (lens missing) and a slightly convex uneven disc of glass. B screws on to the lignum vitæ top C ($1\frac{3}{4}$ in. deep)

of the sliding outer body D ($4\frac{1}{2}$ in. long and $2\frac{5}{8}$ in. in diameter), which consists of cardboard covered with deep crimson leather, with fine gilt tooling. Pasted inside the tube D is a small piece of old printed paper of about 1800, evidently inserted to take up wear in the sliding motion. E is a turned lignum vitæ disc of $2\frac{5}{16}$ in. diameter, carrying a double convex lens of $1\frac{1}{8}$ in. diameter and $2\frac{1}{4}$ in. focal length. This disc is glued to a vellum tube F, $3\frac{3}{4}$ in. long and $2\frac{3}{8}$ in. diameter, which is in turn glued to a lignum vitæ nosepiece G, $2\frac{5}{8}$ in. long. The screw threads at A, B, and C are 14 threads to the inch, and the focusing thread on the nosepiece is $11\frac{2}{3}$ in. threads to the inch diameter 1 in., and $1\frac{1}{4}$ in. long. Below this is a thread to carry the



objective, $\frac{7}{16}$ in. in diameter and $\frac{5}{32}$ in. long. The objective mount H is about $\frac{9}{16}$ in. in diameter and $\frac{1}{2}$ in. long; the thread is 20 threads to the inch; it contains a double convex lens of $\frac{3}{4}$ in. diameter and about $\frac{1}{2}$ in. focal length, set with a brass spring ring; the aperture of the diaphragm is $\frac{1}{16}$ in. The horn disc I, in which the focusing screw of G works, is $2\frac{3}{16}$ in. diameter and only $\frac{7}{64}$ in. thick. The three pillars J are of turned brass, $2\frac{1}{8}$ in. long and $\frac{1}{16}$ in. diameter on the plain part. The circular base K is of lignum vitæ, $3\frac{3}{4}$ in. diameter and $\frac{1}{2}$ in. deep, turned out as shown. A hole $\frac{1}{4}$ in. diameter is drilled through the edge at K. The ordinary working height of the instrument is about 11 in. All the screw threads are well fitted and work smoothly. The whole instrument is excellently made.

OBITUARY.

ALFRED NORMAN DISNEY.

17 June, 1855–16 April, 1929.

F.R.M.S. 1885–1929.

IN the passing of A. N. Disney the Society is the poorer by one of its most loyal and energetic—though unobtrusive—workers, a man to whom the R.M.S. was a real entity, to which he gave unsparingly of his time.

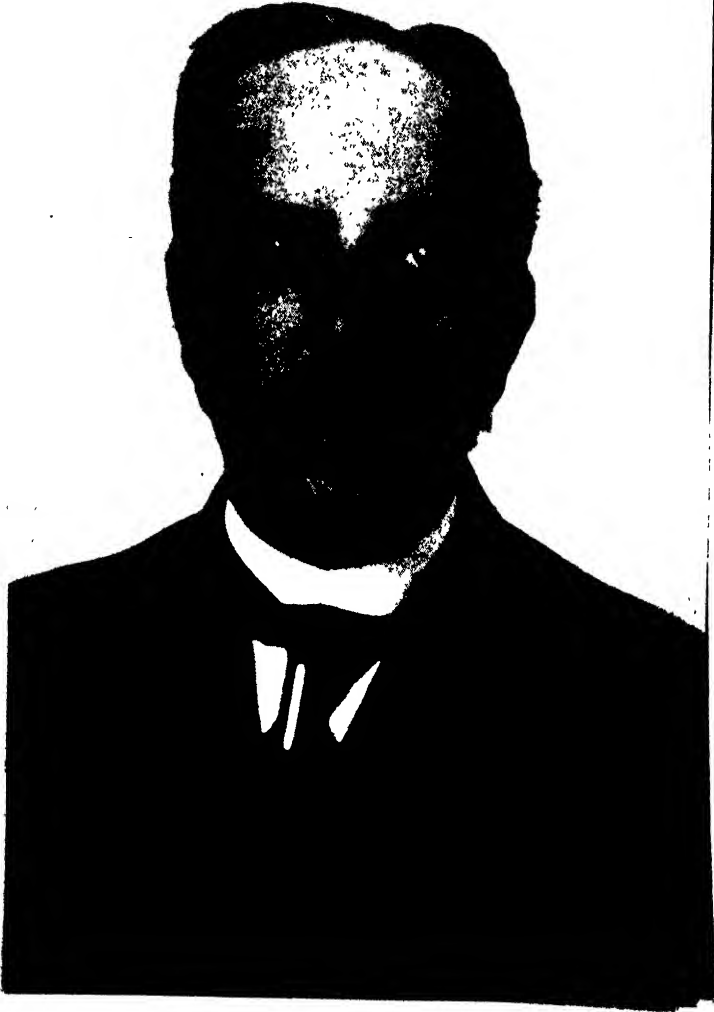
Born at Gloucester, Alfred Norman Disney was educated at Greenwich. On leaving school he entered an architect's office, transferring later for a few years to the offices of a firm of builders. Realising that his inclinations were not towards a business career, he was fortunately able to pass to Trinity College, Cambridge, at the age of twenty-two, whence he graduated four years later Tenth Senior Optime, having also gained two college essay prizes and a Goldsmiths' Company Exhibition. One of the founders of the Cambridge University Review, he contributed to it a series of articles upon the early history of the Cambridge colleges. He later obtained his M.A. Cantab. and B.Sc. London.

After graduation Mr. Disney spent some months studying physics in the Cavendish Laboratory under Lord Rayleigh and Sir Richard Glazebrook, after which he was appointed Science Master at Weymouth College, Dorset (1881). There he devoted attention to the local flora, gaining a prize medal from the Weymouth Town Society for a display of marine algæ.

Headmaster of Islington High School, 1887, he was appointed Headmaster of the Rutlish School, Merton, 1897. This school had been in existence for eighteen months, and there were ninety scholars. How faithfully he toiled may be gathered from the fact that on his retirement in 1921 the school had over four hundred and sixty scholars and a high standard of successes.

Mr. Disney was far from being a schoolmaster in the limited sense. Despite the exacting nature of his profession, his activities were many-sided. He played an active part in the Optical Conventions of 1905 and 1912, was a supplementary member of the British Royal Commissions in connection with the International Exhibitions at Brussels, Rome and Turin, Secretary and Chairman of Division II of the Incorporated Association of Headmasters, member of the Cambridge Antiquarian Society. During the War he worked out a new process for the manufacture of salicylic acid.

To such a man retirement could not mean idleness. After a lifetime passed amid matters educational, he was now able to make wider use of his patient organising ability, and his rich experience was warmly welcomed. Always a philanthropist at heart, he was able to give rein to his sympathies, and



ALFRED NORMAN DISNEY.

was connected—either as secretary or treasurer—with seven different foundations, in whose interests he worked untiringly and with noble selflessness. Even four days before his death, although in failing health, he was present at a meeting of the Charity Commissioners in Whitehall.

In 1886 Mr. Disney was elected a Fellow of the Royal Microscopical

Society, and in 1901 became a Member of Council, upon which he afterwards served several terms. In 1906 he was elected a Vice-President, and was a Member of Council at the time of his death. With his wide and experienced knowledge of the microscope, its application and its history, he was for many years a valued colleague of the editors in the compilation of the abstracts for the Society's Journal.

For many years Mr. Disney attended the meetings of this Society with regularity, and my close association with him commenced in 1921. For two years Mr. Hill and I had been accumulating material for a book, upon ambitious lines, dealing with the microscopes and books relating thereto in the collection of the Society. References needed verification, the whole of the material required digestion and coherence; a vast field of inquiry was open, but only one with a profound knowledge of Latin and Greek could explore it.

Mr. Disney offered his help, and with ready courtesy agreed to become editor, a task the responsibility of which few can realise unless they have had similar experience. Days were spent in the British Museum and in other reference libraries. References had to be traced, errors—which had accumulated and acquired the sanction of years—eliminated; one clue led to another. For seven years we met almost weekly to compare notes. The whole of Part I was written and re-written by hand, some sections being several times recast.

There was in this, as in all else that he undertook, the creative pride of the artist, blended with a willingness to consider suggestions, a modesty which amounted to shyness. His accuracy and method alone made it possible for him to cope with the many interests of which he was guardian. This modesty must have made him seem reserved to strangers or to casual acquaintances, but once the barrier had been passed, the defensive courtesy changed to a deep humanity, and one realised the width of his outlook upon life, the depth and scope of his scholarship, his experience, judgment and warm sympathy.

The many educational and philanthropic bodies with which he was connected will miss him greatly, while those of us who were privileged to know him and to be admitted to his friendship have a very real sense of personal loss.

W. E. W. B.

ABSTRACTS AND REVIEWS.

ZOOLOGY.

(Under the direction of G. M. FINDLAY, M.D.)

HISTOLOGICAL TECHNIQUE AND STAINING.

Elastic Tissue Staining.—R. W. FRENCH (*Stain Technol.*, 1929, 4, 11–12). Weigert's original elastic tissue stain was modified by Prince (*U.S. Veteran. Bureau, Med. Bul.*, 1927, 3, 83), who employed crystal violet in place of basic fuchsin. The following technique gives the best results: (1) Bring sections, affixed to the slide, into water; (2) stain in modified Weigert's elastic stain for $\frac{1}{2}$ to 3 hours. The stain is prepared as follows: crystal violet 2.0 gms., dextrin 0.5 gms., resorcinol 4.0 gms., water, distilled, 200 ccs. Boil in a porcelain dish. When boiling briskly, add 25 ccs. of 29 p.c. aqueous ferric chloride, stir, and continue boiling for from 2 to 5 minutes. A heavy precipitate forms and the mixture assumes a greenish tint. Cool and filter; boil and filter. Boil the precipitate in 200 ccs. of 95 p.c. ethyl alcohol over a water bath. Cool, filter, and make up to 200 ccs. Add 4 ccs. of concentrated hydrochloric acid; (3) differentiate in 95 p.c. alcohol; (4) wash in water. Sections are then stained with Weigert's iron hæmatoxylin and van Gieson's picric acid, acid fuchsin mixture. The elastin is stained a brilliant yellowish green. G. M. F.

Note on Loeffler's Methylene Blue.—H. J. CONN (*Stain Technol.*, 1929, 4, 27). Methylene blue solutions, especially the well-known Loeffler's methylene blue, often fail to keep owing to their alkalinity. Instead of making up the methylene blue in dilute alkali, it is preferable to use the following formula: Methylene blue (medicinal) 0.3 gm., ethyl alcohol 95 p.c., 30 cc. Dissolve and dilute in 100 cc. distilled water. G. M. F.

Histochemical Detection of Adrenalin.—S. BAGINSKI ("Sur la detection histo-chimique de l'adrenaline," *Bull. d'histol et de tech. micr.*, 1928, 5, 129). The pieces of tissue, which should not be larger than 2–3 mm., are fixed for 3–24 hours, according to size, in one or other of the following solutions: (1) ammonium chromate 2 p.c. 30 c.c., silver nitrate 1.25 p.c. 20 c.c., ammonia (0.912 sp. gr.) 3–4 drops. (2) ammonium bichromate 2 p.c. 30 c.c., silver nitrate 1.25 p.c. 20 c.c., ammonia (0.912 sp. gr.) 7–8 drops. After fixation, wash in distilled water until there is no trace of chromium. Dehydrate slowly, clear in chloroform or xylol, not in cedar-wood oil. Sections may be stained with various dyes. G. M. F.

A Method of Staining Flagella.—E. WEISS (*J. Inf. Dis.*, 1928, 43, 228–31). To an 18-hours broth culture glacial acetic acid is added (qs. ad 5 p.c.). The tube is kept in a water bath at 37° C. for 15 minutes. A loopful is transferred to a slide

and dried. A mordant is applied for 2 to 5 minutes, hot. The mordant has the following composition : 100 grs. tannic acid in 100 c.c. 95 p.c. alcohol 1 part, 7.5 c.c. glacial acetic acid in 100 c.c. commercial formalin 2 parts. After mordanting, the slide is washed in warm water for from 1 to 2 minutes and then stained with a basic dye, preferably 5 p.c. gentian or crystal violet in formalin. If the concentration of the basic stain is not higher than 1 p.c., the stain may be applied cold for 4 to 6 minutes ; if higher than 1 p.c., for 1 to 2 minutes. The slide is washed in water and covered with a solution of an acid dye for 10 minutes (preferably acid fuchsin, acid green, or acid violet). The slide is again washed and dried.

G. M. F.

Staining Methods for Bacteria and Yeasts.—W. E. MANEVAL (*Stain Technol.*, 1929, 4, 21-6). To stain flagella actively motile bacteria grown on agar for 20 to 24 hours are allowed to diffuse in sterile water for from 20 to 30 minutes. Droplets of the suspension are transferred to clean slides and allowed to evaporate without spreading. The mordant is then allowed to act for 2 to 4 minutes. Its composition is as follows : tannic acid 10 or 20 p.c. 50 c.c., ferric chloride 5 p.c. 15 c.c., carbol fuchsin (Ziehl-Nielson) 5 c.c., hydrogen peroxide 3 p.c. 6-8 c.c. The mordant keeps for ten or more days. Wash the slide and stain for 2 or 3 minutes with the following : basic fuchsin (saturated alcoholic solution) 10 c.c., anilin oil (1 part) and 95 p.c. alcohol (3 parts) mixed 5 c.c., distilled water 30 c.c., acetic acid 4 p.c. 1 c.c.

G. M. F.

The Atmospheric Oxidation of Methylene Blue.—W. C. HOLMES and E. F. SNYDER ("The Atmospheric Oxidation or Dealkylation of Aqueous Solutions of Methylene Blue," *Stain Technol.*, 1929, 4, 7-10). It has long been known that in alkaline aqueous solutions methylene blue undergoes atmospheric oxidation or dealkylation, with the formation first of trimethyl thionin and formaldehyde, later of asymmetrical dimethyl thionin and dimethyl thionin. At room temperature dilute aqueous solutions of samples of methylene blue are stable below pH 9.5. Oxidation or dealkylation begins between pH 9.5 and 9.8, and increases in both rate and degree with increasing alkalinity. Trimethyl thionin is less stable to atmospheric oxidation than is methylene blue, and undergoes dealkylation at moderate alkalinities which do not affect the latter dye.

G. M. F.

GENERAL CYTOLOGY.

The Structure of Protoplasm.—W. SIEFRIZ (*Biol. Rev.*, 1929, 4, 76-102). An exhaustive review is given of the various theories of protoplasmic structure. On the molecular hypothesis of protoplasmic structure it is possible to reconcile the fluid nature of protoplasm with its elasticity. Linear molecules, properly orientated, form the structural background which accounts for the phenomenon of polarity which is universal in living things. The interlocking of these orientated linear molecules gives to protoplasm its continuity in structure, without which life is inconceivable.

G. M. F.

The Isoelectric Point of Cells and Tissues.—H. PFEIFFER ("Der isoelektrische Punkt von Zellen und Geweben," *Biol. Rev.*, 1929, 4, 1-40). Cells and tissues of plants, and perhaps also of animals, show many reactions similar to those of ampholytes with an isoelectric point. Such are the capacity of imbibition, behaviour towards flocculating agents, acidification of the medium, chemical affinities and probably also permeability and adsorption of ions. This phenomenon is possibly due to the presence of ampholytes on the surfaces of cells and at the boundaries in the interior of the protoplasm. The ampholyte behaviour of tissues,

however, and the reality of their isoelectric point, has up to now been insufficiently tested from the points of view of the permeability to ions and the uptake of substances by protoplasm, of the electro-histological and electropic behaviour of cells, of hydrolyses and condensations in protoplasm and of the mechanism of particular cell functions such as protoplasmic streaming. At the isoelectric point of plasma proteins there is a minimum of physiological functions. The presence of different proteins in protoplasm does not always bring about a collective isoelectric point, for in many instances certain isoelectric points in definite regions of acidity are of predominant importance, possibly in consequence of the successive elimination of the others.

G. M. F.

Histochemical Researches on Pulmonary Anthracosis.—A. POLICARD, S. DOUBROW, and D. PILLET (*Compt. rend. de l'Acad. des Sc.*, 1929, 188, 278-9). By micro-incineration it can be shown that in anthracotic lungs there exist two varieties of pigment: an iron containing substance which is reduced to oxide of iron and is formed from the blood, and also exogenous carbon. In association with the latter are to be found various mineral elements, carbonates, silicates and feldspars.

G. M. F.

Mitochondria in Experimental Acute Nephritis.—R. A. MOORE (*Am. J. Path.*, 1928, 4, 636). The mitochondria were studied in kidney cells damaged by mercuric chloride. The mitochondria in the third part of the convoluted tubule were the first to show any variation. This variation comes after there has been renal insufficiency as evidenced by urea retention. In other words, there is renal insufficiency before there are changes in the mitochondria. The changes noted are slight swelling and marked agglutination. Later the same changes occur in parts 1 and 2 of the proximal convoluted tubules. It is suggested that the mercuric chloride is adsorbed at the mitochondrial cytoplasmic interface.

G. M. F.

The Golgi Bodies of a Cœlenterate.—E. S. HORNING ("Studies on the Golgi Bodies of a Cœlenterate," *Austral. J. Exp. Biol. & Med. Sc.*, 1929, 5, 257-62). Dimorphic Golgi bodies have been detected within the ectodermal cells of *Hydra viridis*. Aggregation of these bodies around the outer surface of the nuclear membrane is a surface tension phenomenon, apparently dependent upon their lipoidal nature. The behaviour of the Golgi apparatus during cytokinesis is also described. During the early prophase these dimorphic elements migrate from the region of the nucleus towards the periphery of the cell, where they undergo fragmentation resulting in the formation of numerous small separate bodies which are later distributed among the daughter cells.

G. M. F.

Sexual Dimorphism in Garter Snake.—C. E. BURT (*Copeia*, no. 166, 2). The majority of specimens show a very distinct sexual dimorphism in the length of the tail, those of the females being longer. The sex of some individuals, however, cannot be distinguished by this method.

F. W. R. B.

Spermatogenesis of Dog.—O. MINOUCHI (*Jap. Jour. Zool.*, 1927, 1, no. 6, 14, 1 pl.). The diploid number in both male and female is 78 and the haploid number 39. The first division is equational for the autosomes. There are two X chromosomes in the female, one X and one Y in the male. The X and Y conjugate in the metaphase of the first division and separate reductionally in the anaphase.

F. W. R. B.

Spermatogenesis of Albino Rat.—O. MINOUCHI (*Jap. Jour. Zool.*, 1927, 1, no. 6, 20, 2 pls.). The diploid number of chromosomes in the male rat is 42 and

the haploid 21. The first division of the autosomes is equational and the second reductional. The X and Y chromosomes form a complex which appears as a heterokaryosome during the growth period. Its first division is reductional and the second equational.

F. W. R. B.

The Chromosomes of the Domestic Mouse.—O. MINOUCHI (*Jap. Jour. Zool.*, 1927, 1, no. 6, 5, 1 pl.). The diploid number of chromosomes in the male is 40 and the haploid 20. There are thus 38 autosomes plus an X and a Y. The heterochromosomes separate in the first division.

F. W. R. B.

Permeability of the Placenta at the End of Gestation to Vital Dyes.—M. ARON ("Perméabilisation du placenta aux colorants vitaux à la fin de la gestation," *Compt. rend. Soc. de biol.*, 1929, 100, 842-4). During pregnancy in the guinea-pig trypan blue does not pass from the maternal circulation into the tissues of the foetus, but immediately before birth the placenta becomes permeable to trypan blue.

G. M. F.

A Double Chick Embryo.—J. L. BHODURI (*Jour. & Proc. Asiatic Soc., Bengal (New Series)*, 1927, 23, no. 3, 4, 1 pl., 1 text-fig.). Two embryos 40 hours old were found in a single blastoderm. They were separate and apparently normal, although the heads were close together and covered by a common amniotic fold.

F. W. R. B.

The Demonstration of the Golgi Apparatus.—R. H. BOWEN ("The Methods for the Demonstration of the Golgi Apparatus. VI. Protozoa. The Vacuome. Plant Tissues." In this paper the various methods which have been used for the demonstration of the Golgi apparatus in protozoa are reviewed at length. The outstanding difficulty appears to be that scarcely any two workers can be found to agree as to what or what does not constitute the Golgi apparatus in the protozoa. This is due to the fact that the specialised Golgi apparatus methods are not specific, and in cases otherwise doubtful the results, for example, of silver or osmium impregnation are well-nigh useless for purposes of critical identification. In addition, the various structures which may be thus demonstrated are not in themselves well enough understood to permit a process of elimination with a subsequent residuum that could be referred to a common Golgi basis. The most suitable method is that of osmic impregnation, the techniques of Hirschler and Kolatcher being the best.

G. M. F.

The Vacuome and Golgi Apparatus in the Course of the Spermatogenesis of *Panorpa communis* L.—G. POLUSZYNSKI ("Vacuome et appareil de Golgi au cours de la spermatogenèse chez la panorpe (*Panorpa communis* L.)," *Compt. rend. Soc. de biol.*, 1929, 100, 780-2, 10 text-figs.). The vacuome, coloured by neutral red, and the Golgi apparatus demonstrated by osmic acid appear quite distinct. The vacuome is definitely polarised during the maturation divisions and appears to be related in some way to the mitochondrial body of the young spermatids.

G. M. F.

Permeability in *Amoeba dubia*.—YUN-ICHI MORITA and R. CHAMBERS ("Permeability Differences Between Nuclear and Cytoplasmic Surfaces in *Amoeba dubia*," *Biol. Bull.*, 1929, 56, 64-7). An aqueous solution of methyl red is yellow in its alkaline and red in its acid range, the turning point of the colour being at the pH of about 5.5. *Amoebæ* stained yellow with methyl red and immersed in solutions of HCl exhibit injury effects by a sudden change in colour from yellow to red in localised regions on the periphery. These regions are pinched.

off and discarded. In a moving amoeba this injury first occurs at the tip of the extending pseudopodia. Sub-lethal concentrations of HCl which do not penetrate the amoeba from without will, when injected into the cytoplasm, readily diffuse into the nucleus without causing irreversible injury. On the other hand, the wall of the contractile vacuole appears to be similar to that of the plasmalemma of the amoeba in regard to the non-penetrability of HCl. G. M. F.

Transmission of Fowl-Pox by Mosquitoes.—I. J. KLIGLER, R. S. MUCKENFUSS, and T. M. RIVERS (*J. Exp. Med.*, 1929, 49, 649–60, 3 pls.). *Culex pipiens* and *Aedes aegypti* are capable of transmitting fowl-pox from diseased to healthy susceptible chickens; the mosquitoes remain infectious for at least 14 days following a meal on diseased fowls. These results confirm those previously obtained by Schuberg and Kahn on the power of *Stomoxys calcitrans* to transmit this virus. G. M. F.

Virus III in Tissue Cultures.—C. H. ANDREWES ("Virus III in Tissue Cultures. I. The Appearance of Intranuclear Inclusions in vitro," *Brit. J. Exp. Path.*, 1929, 10, 188–90). Virus III multiplies in adult rabbit testis which is surviving in "tissue cultures" in dilute rabbit plasma or serum. It has been carried through 10 serial cultures, corresponding to a multiplication of over 10^{11} times. The intranuclear "inclusions" associated with infection with this virus are regularly formed in the plasma cultures; they may also be found in serum cultures. G. M. F.

Cultivation of Vaccinia Virus.—G. H. EAGLES and D. McCLEAN (*Brit. J. Exp. Path.*, 1929, 10, 35–44). Vaccinia virus has been cultivated using tissue culture methods, and carried through four generations in sub-culture. It is suggested that active growth of tissue is not essential to increase in virus. Brain tissue appeared more suitable than whole embryo for cultivation: the most regular growths were produced when a strain of neuro-vaccine adapted to the rabbit's testicle was used as a source of virus. G. M. F.

The Cultivation of Vaccine Virus.—R. N. NYE and F. PARKER ("Studies on Filterable Viruses. III. Further Observations on Vaccine Virus," *Am. J. Path.*, 1929, 5, 147–55). Further experiments are described demonstrating the multiplication of vaccine virus in tissue cultures. Vaccine virus could not be cultivated using killed tissues or under anaerobic conditions. The optimum hydrogen ion concentration for survival of the virus in glycerine was pH 7.0. G. M. F.

A Study of the Intranuclear Inclusions of Yellow Fever.—C. MARGARINOS TORRES ("Etude par le procédé de Goodpasture et la réaction de Feulgen, des inclusions nucléaires, de la fièvre jaune expérimentale," *Compt. rend. Soc. de biol.*, 1929, 100, 966). By the method of Goodpasture for the colouration of Negri bodies the nucleoli are coloured red, while the acidophilic intranuclear inclusions are coloured blue, and in their early stages show a reticular structure. The inclusions do not give the Feulgen reaction for thymonucleic acid. G. M. F.

Histology.

Histology of the Ovary of the Rabbit.—A. L. SALAZAR (*Arch. portugaises des Sci. biol.* 1925, 1, fas. 2, 262, 28 pls.). The rabbit ovary is studied from the point of view of the tanno-ferric method. The structure of the Graafian follicles, epithelial cords, and interstitial cells of the adult ovary are dealt with at length and in detail. F. W. R. B.

Vascular System of Spiny Dogfish.—C. H. O'DONOGHUE and E. ABBOTT (*Trans. R. S. Edin.*, 1928, 55, 33, 67, 20 text-figs.). The blood vascular systems of the two species of spiny dogfish studied are strikingly similar and only differ in unimportant details. This system is one of the most primitive and least specialised of any elasmobranch. It furnishes, therefore, an excellent basis for comparison with other forms. The embryos, like those of other vertebrates, have six complete branchial arches between the dorsal and ventral aortæ. These are retained in a remarkably complete manner in the adult. This primitive arrangement indicates that the spiny dogfish, amongst living forms, approaches most closely to the ancestral condition of higher vertebrates. F. W. R. B.

The Regeneration of Gastric Glands.—A. N. FERGUSON ("A Cytological Study of the Regeneration of Gastric Glands following the Experimental Removal of Large Areas of Mucosa," *Am. J. Anat.*, 1928, 42, 403–42, 18 text-figs.). After artificial gastric ulcers in the dog the regenerating epithelium is at first composed entirely of foveolar cells. This epithelium is then invaginated and gland anlagen formed. Mucous chief cells are differentiated at the bottom of these gland tubules, and soon there are present rather long glands composed entirely of mucous chief cells which open into deep foveolæ. Mucous chief cells at the bottom of these early glands are next transformed into parietal cells and serous chief cells. Zymogen granules have not been found in any of the newly-formed serous chief cells by the technique employed. It appears that the specialised cells of the gastric glands are capable of passing through a cycle of transformation in response to injury followed by regeneration. G. M. F.

Pigmentary Cells in the Skin of the Eel.—A. PANU ("Sur les cellules pigmentaires de la peau de l'anguille (*Anguilla anguilla* L.)," *Compt. rend. Soc. de biol.*, 1929, 100, 481). A yellow pigment which is a mixture of carotin and various lipoids is found in the cells placed immediately below the basal member. Immediately below the basal layer are also cells containing crystals of guanin. These cells lie in close contact with the melanophores which are also found in the fatty connective tissues and in the connective tissue sheaths of the muscles. G. M. F.

The Digestive System of the Eel-Pout.—M. E. MACKAY ("The Digestive System of the Eel-Pout (*Zoarces anguillaris*)," *Biol. Bull.*, 1929, 56, 8–23, 4 text-figs.). The eel-pout has a true anatomical stomach. The common bile and pancreatic duct open into the duodenum below the pyloric sphincter. The reaction of the stomach in both fasting and fed animals is near the neutral point, ranging from a pH of 6.5 to 8.4. The reaction in the duodenum is slightly alkaline. Digestive juices removed from both the stomach and duodenum had a lipase, amylase and a very strong proteolytic enzyme, digesting at a pH near the neutral point. G. M. F.

The Thyroid Gland and Feeding with Pituitary and Potassium Iodide.—H. A. MCCORDOCK ("The Effect of Combined Feeding of Potassium Iodide and Anterior Lobe of the Pituitary upon the Thyroid Gland," *Am. J. Path.*, 1929, 5, 171–8, 3 pls.). Oral administration of anterior pituitary tablets causes a depression in the activity of the thyroid, with a marked lowering of the number of mitoses in the entire gland and with medium-sized or somewhat smaller acini distended with hard colloid compressing the lining epithelium into thin strands of cells. During the first stage of its action, potassium iodide, on the other hand, causes a stimulation with great mitotic activity and a slightly softened colloid occasionally

containing many phagocytic cells. The early proliferative change caused by potassium iodide is prevented by anterior pituitary when both these substances are fed to the same animal.

G. M. F.

Pernicious Anæmia and the Toxins of *Bacillus welchii*.—J. C. TORREY and M. C. KAHN ("The Progressive Anæmia following a Single Intramarrow Injection of *b. welchii* Toxins," *Am. J. Path.*, 1929, 5, 117-40, 2 pls.). A single inoculation of 0.5 c.c. of a sterile *b. welchii* toxin into the tibial marrow of a rabbit or a monkey gives rise to a chronic and often fatal anæmia characterised by low hæmoglobin content of the blood, low erythrocyte count, and a colour index generally above 1.0. Anisocytosis and at times poikilocytosis are pronounced. The anæmia is due to a degenerative process which affects the whole bone marrow system. Evidence of beginning degenerative changes can be noted histologically within 18 hours of inoculation on the side of the body opposite to that on which the inoculation was made. After 12 days there is mucous degeneration of the fat cells, diminution in other normal marrow, and a great increase in polymorphonuclear leucocytes. Eleven or more weeks after the inoculation the fat cells of the marrow were replaced by a granular material, while the cellular elements all showed an extreme atrophy. Intravenous inoculation of the toxin of *b. welchii* gives rise to an anæmia of the same type, but is followed within three or four weeks by an immunity and a return of the blood to normal. The cause of the difference in effect between intravenous inoculation and injection into the marrow direct is not clear.

G. M. F.

INVERTEBRATA.

Mollusca.

The Growth of a Pond Snail.—E. D. CRABB ("Growth of a Pond Snail, *Lymnaea stagnalis appressa*, as indicated by Increase in Shell Size," *Biol. Bull.*, 1929, 56, 41-63, 9 text-figs.). A method of rearing pond snails in the laboratory for experimental purposes is described. A diet composed of lettuce, boiled wheat grains and filter paper produced the best results in growth and in number and viability of eggs laid, provided the medium was favourable. Food insufficiency and foul media are the most common growth inhibiting factors in snails reared in otherwise favourable media. Extreme crowding markedly retards growth, but the individuals rapidly reach the norm after being isolated under standard conditions, unless too old at the time, when they may fail to reach normal adult size. Volume of medium has relatively little effect on the growth of isolated snails, provided foulness is not permitted. Aeration promotes growth through reducing foulness of the medium by oxidising decaying substances, but has no appreciable respiratory significance, since these animals normally breathe atmospheric oxygen. Direct sunlight does not increase the growth rate over that of sunlight which has passed through plate glass. There is no evidence that dwarfing produced by unfavourable culture conditions is transmitted.

G. M. F.

Arthropoda.

Insecta.

Inheritance of Wing Length in Weevils.—D. J. JACKSON (*Trans. R. S. Edin.*, 1928, 55, 27-77, 7 pls., 4 text-figs. and 5 genealogical diagrams). The weevil *Sitona hispidula* was bred and crosses were made between the long- and short-winged forms. These showed that the brachypterous condition behaves as a simple Mendelian dominant. The reduction of the wings of beetles is only one

of a series of conditions frequently found associated together, including atrophy of the winged muscles, ankylosis of the elytra, etc. It is suggested that such changes must be attributed either to a regressive orthogenesis or to a succession of chance mutations. The latter theory would be compatible with the conditions in *Sitona*, where the reduction of the wings and their muscles is often not correlated. It is pointed out that once the wing muscles were suppressed and flight consequently rendered impossible, further mutations resulting in the reduction of the wings and ankylosis of the elytra could not be harmful to the species. Owing to the frequent occurrence of the apterous condition in beetles in all sorts of environments, it appears probable that the capacity or incapacity for flight is of little importance in determining the survival of most species.

F. W. R. B.

Revision of *Hesthesis*.—H. J. CARTER ("Revision of *Hesthesis* (Fam. *Cerambycidae*), together with the Description of a New Genus and Species of the *Buprestidae*," *Proc. Linn. Soc. N.W. Wales*, 1928, 53, pt. 5, no. 219, 543-50, 1 text-fig.). The genus *Hesthesis* contains what are known in Australia as the "wasp" longicorns, and these are found commonly on flowers of *Leptospermum*, *Eucalyptus*, and *Angophora*. In life their jerky, restless movements, their short elytra and evident wings, make their resemblance to some of the Thynnid wasps very remarkable, especially in the females, with their shorter antennæ. In most species it is curious that the females are much more common than the males. The long series available has enabled the author to study the variations and distribution of the several species, and to obtain some knowledge of the constant characters that delimit them. The species vary considerably in size, *ferruginea*, *cingulata* and *angulata* being the largest, and *acutipennis*, *montana*, *variegata* and *ornata* the smallest; but in all species the male is generally much smaller than the female. Thus in *ferruginea* an average of 8 males gives 18 mm. long; of 8 females, 27½ mm.; in *acutipennis*, males range from 10 mm. long, while females measure up to 19 mm. long. Similarly with other species. The males of *cingulata*, *ferruginea*, and *resparia* are generally darker in colour than the females. The only structural characters by which the species can be separated are (1) the hind margins of the elytra, and (2) to a much lesser extent, the sides of the prothorax. This latter character is apt to be elusive, the sides being more often subangulately widened than is stated by authors; *acutipennis*, *montana*, *variegata*, *ornata*, *vigilans* and *crabroides* often—though not invariably—show a decided angulation. In the other species the sides are variably but more or less strongly rounded. The hind margins of elytra are thus the most defined of the structural characters, and the species fall into two fairly well distinguished groups on this alone. The following new species are described: *Hesthesis crabroides* n. sp., *Hesthesis assinilis* n.sp. or sub-sp., *Hesthesis montana* n. sp., *Epania australis* n. sp., *Theryaxia* n. gen., *Anthaxites Theryaxia suttoni* n. sp.

M. E. M.

African Chrysididæ.—H. BRAUNS ("Beitrag zur Kenntnis Afrikanischer Chrysididen (Hym.)," *Entomologische Mitteilungen*, 1928, 17, no. 6, 383-93, 7 text-figs.). A description is given of the following genera and species: *Spimtharis arnoldi* n. sp., *S. bispinosa* Mocs., *Allocælia trautmanni* n. sp., *Tetrachrysis trautmanni* n. sp., *Tetrachrysis arnoldi* n. sp., *Hexachrysis dentipleuralis* n. sp., *Hexachrysis van Soni* Brauns, *Odontochrydium* n. gen. *trautmanni* n. sp., *Chrysidium* n. gen., *Chrysidium antiquum* n. sp., *Chrysidium* Br. *Heterochrysis* n. sub-gen., *Heterochrysis braini* n. sp.

M. E. M.

The Insect Head.—R. E. SNODGRASS ("The Morphology and Evolution of the Insect Head and its Appendages," *Smithsonian Misc. Coll.*, 1928, 81, no. 3,

1-158, 57 text-figs.). This extensive and well-illustrated paper is divided into the following seven sections: Evolution of the Arthropod Head, the General Structure of the Insect Head, the Head Appendages, a Summary of the Important Points, the Head of a Grasshopper, Special Modifications in the Structure of the Head, and the Head of a Caterpillar. It is impossible at present to arrive at final conclusions on the many problems connected with the morphology of arthropod appendages, and the most that the writer would claim for the present attempt at advance in the subject is that the material here presented gives at least a substantial enlargement to the foundation of known facts from which future work must proceed. There is no question that students of arthropods have given far too little attention to the relationship between skeletal structure and musculature. The more the subject is looked into, the more it will be seen that the characters of the arthropod skeleton are in large part adaptations to the strain of muscle tension, and that they are to be correctly interpreted only through an understanding of the entire mechanism of which they are a part. The sclerites of the insect cuticula, in particular, have been studied as if they were skeletal elements definitely fitted together in such a manner as to cover the outside of the animal, and entomologists have played with them as we might with the sections of a picture puzzle, without looking for their significance in the mechanics of the insect. The arthropod skeleton has been formed from a few major centres of increased chitination, but the minor divisions are in almost all cases adaptation to flexion, or the opposite, namely, the strengthening of the skeleton by the development of internal ridges. The scientific study of the comparative anatomy of insects must look for its advance in the future to a wider knowledge of muscles and mechanism. The following are a few of the author's conclusions: the arthropods have been derived from creeping animals, not from forms specially modified for swimming; their immediate progenitors were annelid-like in structure. The stomodeum marks the anterior end of the blastopore. There are, therefore, no true mesodermal segments anterior to the mouth. The unsegmented preoral part of the animal is the prostomium, and constitutes the most primitive head, or *archicephalon*, of segmented animals, since it contains the first nerve centre, or *archicerebrum*, and bears the primitive sense organs. The first stage in the development of the composite head in the arthropods, as represented in the embryo, comprises the prostomium and the first two or three postoral segments. The head at this stage may be termed the *protocephalon*; it is represented by the cephalic lobes of the embryo, which may or may not include the third segment. The gnathal region was eventually added to the *protocephalon* for the definitive head, or *telocephalon*. In the definitive head the prostomium, according to some embryologists, contributes the clypeus and frons and the region of the compound eyes; according to others, it forms the clypeus and frons only. The labrum is a median preoral lobe of the prostomium.

M. E. M.

Variability of Species in the Lepidoptera.—R. A. FISHER and E. B. FORD ("The Variability of Species in *Lepidoptera*, with Reference to Abundance and Sex," *Trans. Ento. Soc. Lond.*, 1929, 76, pt. 2, 367-84, 1 pl.). The present paper contains the results of recent work which the writers have carried out independently. They have, on the one hand, studied the variation to be expected theoretically in a population exhibiting Mendelian inheritance under the influence of selection, and, on the other, investigated the variability of certain *Lepidoptera*, chiefly certain British moths. The conclusions at which they have arrived showed agreement, and have been already published in a preliminary note (Fisher and Ford, 1926). Herein they discuss these conclusions in greater detail. Prof. E. B. Poulton contributes an appendix entitled "On the Male and Female Forms of

the African Pterothysanid Moth *Hibridides norax* Druce." The authors' conclusions are as follows: (1) The frequency distribution of depth of pigment in the ground colour of the fore-wings of 35 species of British moths has been obtained by comparison of over 5,000 specimens with a standard colour scale. (2) For comparison of variabilities of groups of different average tint the standard deviations have been adjusted to eliminate any arbitrary elements which might have been introduced by the scale employed. (3) The mean tint is darker in the females than in the males, and is also darker in the more abundant than in the less abundant species. (4) Even after adjustment the mean variance is about 30 p.c. higher in females than in males, and is in both sexes greatest in the abundant species and least in those which are less than common. (5) It is also possible, though the difference is not in this material statistically significant, that the species with the wider range are, in any one locality, the more variable. (6) The association of variability with abundance accords with an early generalisation of Darwin's and with the theory that variability is determined by a balance between the influences of mutations and selection. This theory is insufficient numerically to account for the large differences in variability between the sexes. (7) In view of the frequency of polymorphism and other marked variations, in the females as opposed to the males in lepidoptera, it is suggested that the male sex hormones may inhibit a number of the factors influencing the development of pigment, as in the well-known sex-controlled variation. The suggestion of Goldschmidt that there exist pigmentation factors in the Y-chromosome capable of interaction with autosomal factors to cause pigmentary differentiation is an alternative view which may account for a few cases. This should result in purely female unisexual polymorphism (except for the possibility of occasional crossing-over between the X- and Y-chromosomes), but it is almost certainly an infrequent phenomenon. It is possible that sexual selection may in part be responsible for the complete inhibition of mimetic patterns in the males of certain mimetic species.

M. E. M.

European Bees.—O. W. RICHARDS ("A Revision of the European Bees allied to *Psithyrus quadricolor* Lepeletier (*Hymenoptera, Bombidae*)," *Trans. Ento. Soc. Lond.*, 1928, **76**, pt. 2, 345-65, 1 pl.). It has for some time been doubtful how many species could be distinguished within this group of *Psithyrus*. There has been a tendency to suspect that all the European forms may be only varieties of one species, and in any case it was not known that the supposed species differed except in their colour patterns. These facts have led the author to examine as much material as he could obtain of these bees, and the present paper distinguishes the five species into which it is thought the group must be divided, and also describes their colour variation, notes on two allied non-European species being added. The *Ps. quadricolor* group is defined, and a table by which the species may be distinguished is provided. A systematic account of the species follows, in which original descriptions are included, *Psithyrus meridionalis* n. sp., a possible geographical race of *Ps. quadricolor*, here being given specific rank. The hosts of the *quadricolor* group of *Psithyrus* are discussed, and the paper is concluded with a systematic summary.

M. E. M.

New Bethylidæ.—O. WHITTAKER ("New *Bethylidæ* (*Hymenoptera*) from British Colombia," *Trans. Ento. Soc. Lond.*, 1929, **76**, pt. 2, 385-90, 1 pl.). The specimens upon which the following descriptions are based were all taken by the writer. The first captured specimens were sent for identification to Mr. R. M. Fouts, of Washington, who returned them with the information that they represented hitherto undescribed species. Herein the following species are described:

Bethylus brachypterus n. sp., *Bethylus flavicornis* n. sp., *Pseudisobrachium agilis* n. sp., *Laelius occidentalis* n. sp., *Gonatopus foutsii* n. sp., *Gonatopus septentrionalis* n. sp., *Aphelopus microtomus* n. sp., *Apogonops pilicornis* n. sp. M. E. M.

Thysanoptera of India.—T. V. RAMAKRISHNA AYYAR ("A Contribution to Our Knowledge of the *Thysanoptera* of India," *Mem. Dept. Agri. India, Ento. Series*, 1928, 10, no. 7, 217-316, 2 pls., 32 text-figs.). In India the insect order which forms the subject of this paper has hitherto received very scant attention from entomologists in comparison with that bestowed on other major divisions of the large group Insecta. That these creatures are not in any way scarce in the country has been found by recent experience. This apparent neglect, therefore, may perhaps be attributed mainly to the small size, the unattractive colours, and the unobtrusive habits of these insects. The author's serious attention was drawn to this group of insects for the first time in May, 1915, when he noted a species of "thrips," since described as a new species *Thrips oryzae* Williams, causing some appreciable injury to the rice crop in the Chingelput district in S. India. In the present paper the author brings together, as a connected record, our knowledge of all the *Thysanoptera* so far known from India, not only by presenting the results of study of his own collections, both by others and himself, but also by the incorporation of all other records published on the Indian forms. The paper does not presume to be a complete account of all Indian *Thysanoptera*, but it is hoped that this contribution may be useful to others who may attempt to advance our fund of knowledge of this little-known group of Indian insects. The previous work on the Indian *Thysanoptera* is discussed, and the material and methods used in this study are described. The general characters of the *Thysanoptera*, with special reference to the Indian forms, are dealt with under: (1) form, shape, and structural features; (2) life-history; (3) food, habits, and natural enemies; (4) economic status; (5) distribution, affinities, and means of dispersal. The classification receives attention, and a systematic account of the Indian forms *Trebrantia* and *Tubulifera* follows, the paper being concluded with a list of species recorded in this memoir.

M. E. M.

Butterflies of Epping Forest.—A. W. MERA ("Stray Notes on the Butterflies of Epping Forest," *Essex Naturalist*, 1928-29, 22, pt. iv, 201-2). The great interest of the season of 1928 has been the large numbers of migratory insects that have visited our coasts from abroad and have penetrated inland as far as Epping Forest. These species probably may not occur again in the neighbourhood for some years to come. Particularly may be mentioned the Clouded Yellow, *Colias croceus*, which the author reports having seen in some numbers in the less-frequented open spaces of the forest. The same remarks may be applied to the Painted Lady, *Pyrameis cardui*. Probably last year's immigration will prove to be one of the most widely spread invasions of the latter species ever recorded. The author gives a list of some 20 indigenous species recorded from the forest, including *Pararge egeria*, the Speckled Wood, which has disappeared within his memory. In 1868 it was fairly common in the higher parts of the forest, but disappeared soon afterwards. Its congener, the Wall Butterfly, *P. megoera*, has had a more erratic existence. It had never been met with in the forest before August, 1919, but from that time up to June 2, 1922, it was frequently seen, although it again seems now to be absent. *Thecla betulae* is another insect that apparently may be considered one of the "glories of the past." The author has not since 1881 taken larvæ from Epping Forest, though he has been given to understand that it was taken as late as 1895. The list shows that it is by no means a rich

one. There is every reason to think that in Doubleday's time, judging from his records, insect life in the forest was far more abundant than at the present day.

M. E. M.

Arctiidae, Noctuidae, and Sphingidae from French Oceania.—C. L. COLLENETTE ("The Arctiidae, Noctuidae, and Sphingidae of the 'St. George' Expedition, from French Oceania," *Trans. Ento. Soc. Lond.*, 1929, 76, pt. 2, 469–87, 1 pl., 2 text-figs.). The collection here dealt with was obtained during the course of the "St. George" Expedition, 1924–25, to which have been added those obtained by Miss L. E. Cheesman, after leaving the expedition, in the Islands of Tahiti, Raiatea, and Bora Bora (Society Islands). The most interesting species were obtained at night in the elevated regions of the volcanic islands, especially on Mt. Temetie, in Hiva Oa, at a height of 3,500 ft. There seems little doubt that further collecting on these mountains would yield extremely interesting results. A description, with notes on the distribution, is given of the following genera and species: *Arctiidae-Nolinæ*; *Celama insularum* n. sp.; *Arctiinae*, *Utelheisa pulchelloides* Hmps. n.; *Noctuidae-Agrofinæ*, *Chloridea assluta* Guen.; *Hadeninae*, *Tiracola plagiata* Walk.; *Acronyctinae*, *Calloplistria meridionalis* n. sp.; *Calloplistria ouria* n. sp.; *Prodenia litura* Fab.; *Spodoptera mauritia* Boisd.; *Perigea serva* Walk.; *Elydna nonagricola* Walk.; *Chasmina tibialis* Fab.; *Erastrinae*, *Eublemma rivula* Moore; *Anyna natalis* Walk.; *Anyna octo* Guén.; *Eustrotia rusemæ* Snell; *Euteliinae*, *Phlegetonia delatriæ* Guén.; *Stictopterinae*, *Gyrtona divitalis* Walk.; *Westermanniinae*, *Earias huegeli* Rogenh.; *Catocalinae*, *Anua coronata* Fab.; *Achæa marquesanus* n. sp.; *Achæa janata* Linn.; *Grammodes oculicola* Walk.; *Hypætra discolor* Fab.; *Mocis frugalis* Fab.; *Mocis trifasciata* Steph.; *Phytometrinae*, *Phytometra chalcites* Esp.; *Phytometra albostrata* Brem.; *Ophiderinae*, *Polydesma umbricola* Boisd.; *Ædia sericea* Butl.; *Anomis flava flava* Fab.; *Anomis vitensis* Butl.; *Anticarsia irrorata* Fab.; *Hypeninae*, *Simplicia cæneusalis* Walk.; *Hydrilodes melanozona* n. sp.; *Hydrilodes crispipalpus* n. sp.; *Hypena walkeri* n. sp.; *Hypena longfieldæ* n. sp.; *Hypena sanctigeorgii* n. sp.; *Fautaua* n. gen.; *Fautaua diagonalis* n. sp.; *Fautaua immupta* n. sp.; *Luceria oculalis* Moore; *Hyblæinae*, *Hyblæa pueræ* Cram.; *Sphingidae-Acherentiinae*, *Horse convolvuli* Linn.; *Philampelinae*, *Chromis ertous eras* Boisd.; *Macroglossum hirundo hirundo* Boisd.; *Chærocampinae*, *Hippotion celerio* Linn.

M. E. M.

Bionomics of Lepidoptera.—C. L. COLLENETTE and G. TALBOT ("Observations on the Bionomics of the Lepidoptera of Matto Grosso, Brazil," *Trans. Ento. Soc. Lond.*, 1929, 76, pt. 2, 391–414, 5 pls., 1 text-fig.). The insects dealt with in this paper were taken in Matto Grosso during the period April–November, 1927. They are listed in tabular form on p. 401, and seven of the eight localities dealt with are indicated in the accompanying sketch map. It was first proposed to confine the account to butterflies captured in the locality alluded to as "Rio Serragen," but the remainder have been included for comparative purposes and to illustrate certain remarks on the insects dealt with. Of the species mentioned, an endeavour was made to take every specimen seen. The following are the eight localities surveyed—Rio Serragen, Urucum, Cuyaba, Nobres and Melguira, Burity, Tombador Falls, and Tombador Sitio. An account is given of the gathering of butterflies on damp sand, experiments which were undertaken furnishing evidence that the insects were induced to select sites frequented by animals and man, one determining factor being the presence of animal perspiration and its odour on the particular sand sites. The attraction of moths to human perspiration was studied, it being found that the most successful method of

attracting moths at night in Matto Grosso was by means of human perspiration. The method used was to hang up in trees and bushes a number of garments which had been previously worn. The freshness of the perspiration was immaterial, and when the same garments were hung up for several successive evenings, their power of attraction was increased rather than diminished. A garment rinsed in a stream to remove the perspiration was afterwards quite disregarded. In the case of moths damp sand was much less attractive than the garments. Experiments were made with the garments of different persons, including the coat of a negro and those of several Brazilians of Portuguese and mixed descent. No difference in the attractive powers of the garments was observable. Although human perspiration is so attractive to moths in Matto Grosso and eastern Bolivia, the author states that he has been unable to find any account of similar attraction in other parts of the tropics. During the expedition a series of notes was taken on the odour of *Heliconius erate phyllis* Fab. and *H. melpomene burchelli* Poulton, this investigation proving that there are several degrees of odour associated with the insects, independent of their age. The paper concludes with "A Systematic Account of the Butterflies Concerned, together with Descriptions of New Forms," 28 species being considered. M. E. M.

Micro-Lepidoptera from the Pacific Islands.—E. MEYRICK ("The Micro-Lepidoptera of the 'St. George' Expedition," *Trans. Ento. Soc. Lond.*, 1929, 76, pt. 2, 489-521). The present paper is a continuation of the description of the micro-lepidoptera collected by the "St. George" Expedition during 1924-25. Over 1,000 specimens were included in the present consignment, of which about two-thirds are from the Pacific Islands, the remaining third being from small islands closely adjacent to the American coast. These two sections are entirely unrelated, and are treated separately. The author discusses the disconnection of Polynesian and South American faunas, and concludes that, so far as the evidence goes, there is no trace whatever of any communication between these regions. The Marquesas are actually rather nearer to South America than to Australia, but the fauna of the Pacific Islands is entirely of Indo-Malayan type. The American species all belong to a particular (more primitive) section; from Fiji to the Marquesas nine species are now known, and all of these belong to the other section, and are of obvious Indo-Malayan type. Hence it appears that in such a case, the genus having originated in the Indo-Malayan region (where both sections are found), America can only have received its first representatives of the genus by way of Africa, and, in the absence of any evidence to the contrary, it must be assumed that the same explanation holds good for all similar cases. This is considered to be an important aid in tracing geographical distribution. The Polynesian species are discussed, and the paper is mainly occupied with a descriptive list of the numerous species. M. E. M.

Lepidoptera in the Hope Department, Oxford.—C. F. WOODFORDE, E. B. FORD, L. B. PROUT, and E. B. POULTON ("Varieties of British Lepidoptera in the Hope Department, Oxford University Museum," *Trans. Ento. Soc. Lond.*, 1929, 76, pt. 2, 523-31, 1 pl.). Descriptions are given of the principal varieties. M. E. M.

Pollination of an Australian Orchid by an Ichneumonid.—E. COLEMAN ("Pollination of an Australian Orchid by the Male Ichneumonid *Lissopimpla semipunctata* Kirby," *Trans. Ento. Soc. Lond.*, 1929, 76, pt. 2, 533-9, 2 pls., 1 text-fig.). The interesting observations which form the subject of the present paper were first made by the daughter of the author, but afterwards were frequently confirmed by both naturalists at Upwey and Belgrave, Victoria. Mrs. Coleman has

published an account of the discovery in *The Victorian Naturalist* (1927, 44, 20, and 1928, 333). The orchid, *Cryptostylis leptechila* F.v.M., only occurs in New South Wales and Victoria, but the ichneumonid, *Lissopimpla semipunctata* Kirby, is common to all the States. When the orchid is transferred to another district where it is unknown, the male ichneumon almost at once detects its presence and seeks it. The male only visits the orchid, and from its actions it is apparent that it regards the flower as a female of its own species, and enters it under this impression. The flower to some extent resembles the female both in shape and colour, and it is probable that it gives off a perfume which is attractive to the male. The orchid's disc or gland adheres to the dorsal surface of what is apparently the last segment of the insect, and when leaving the flower the pollinia are at right angles to the insect's body, afterwards falling to a position parallel with it and ready to touch the stigma of the flower next visited. The author states that she is convinced that true copulation between the male insect and the flower takes place, and that she has been able to observe the deposited spermatozoa on the disc of the flower.

M. E. M.

Syntomidae of Formosa.—A. E. WILEMAN ("Horæ Formosanae: the Syntomidae of Formosa," *Trans. Ento. Soc. Lond.*, 1929, 76, pt. 2, 417–52, 1 pl.). The materials referred to in the present survey of the *Syntomidae* of Formosa are to be found, for the most part, in the following museums and collections: British Museum (Natural History); Zoological Museum, Tring; Deutsche Entomologische Institut (Museum), Berlin-Dahlem; the Matsumura Collection in the Entomological Section of the Hokkaido Imperial University, Sapporo, Japan; and the Wileman Collections. As far as can be ascertained at present, there are three genera, thirteen species, and four sub-species of *Syntomidae* which occur in Formosa. Eight of these species seem to be peculiar to the Formosa fauna, as they are apparently not found in other countries. Three species occur in Formosa and other countries. Two species, *horishana* and *hoppo*, may be referable to two species, already named and described, which are found in China (East Central) and Nepal, India.

M. E. M.

Rhopalocera from French Oceania.—E. B. POULTON ("The *Rhopalocera* of the 'St. George' Expedition, from French Oceania," *Trans. Ento. Soc. Lond.*, 1929, 76, pt. 2, 453–68, 1 pl., 2 text-figs.). The contained list is based upon the collections made by the "St. George" Expedition to the South Pacific Islands in 1924 and 1925, now in the British Museum Collection, and by Miss Cheesman in 1925 in the Society Islands. These have been supplemented to some extent by material in the British Museum derived from other sources. Prof. Poulton is responsible for the accounts of *Dp. exippus*, *E. eleuthe* and *H. bolina*, and Riley for the remainder of the *Rhopalocera*. Mr. Collenette, who, with Miss Longfield, collected the lepidoptera obtained during the "St. George" Expedition, has added a number of field notes. The following genera and species are dealt with: *Dunaida plexippus* Linn., *Euplœa eleuthe walkeri* Druce, *Euplœa erope* Bois., *Hamadryas zolus* Fab., *Libythea collenettei* n. sp., *Atella gaberti* Guérin-Meneville, *Precis villida longfieldæ* s.sp. nov., *Melanitis leda solandra* Fab., *Hypolimnas bolina* Linn., *Zizera labradus cheesmanæ* s.sp. nov., *Jamides walkeri ruruturi* s.sp. nov., *Catochrysops taiensis* Bois., *Hypojamides* gen. nov., *Hypojamides catochloris* Bois., *Thecla ocrisia* Hew., *Hesperidae*: *Badamia exclamations* Fab. M. E. M.

Stone-Flies of Japan.—MASUZO UENO ("Studies on the Stone-Flies of Japan," *Mem. Coll. Sci., Kyoto Imp. Univ.*, 1929, 4, series B, no. 2, 97–155, pl. xxiv, 26 text-figs.). Notwithstanding numerous records of Japanese stone-flies

(*Plecoptera*), studies of their immature stages have been almost completely neglected, the only description being a short article with three illustrations by Kawamura (*ibid.*, 1918, 1, 264-6). In the present paper are chiefly recorded well-defined nymphs representing the 14 known genera and a curious nymph of a new genus *Scopura*. In addition to the immature forms here recorded, descriptions are given of six adult stone-flies which, in the author's opinion, are new species. The stone-fly fauna of Japan is exceedingly rich, having many representatives of each family. With the majority the emergence usually begins in April, and lasts until July. In the alpine regions in central Japan, at an altitude of 1,900-2,800 metres, however, some of the *Perlids*, *Capnids*, and *Nemouras* emerge even in August. One of the *Nemouridæ* can be found at the beginning of February creeping about on the snow. From the zoogeographical standpoint, all the Japanese genera are Holarctic, of which the Palearctic elements are more numerous than the Nearctic, and the majority of the species seems to be peculiar to Japan. The author discusses the probable distribution of the genera at some length. A key to the genera of the nymphs found in Japan is given, and the remainder of the paper is devoted to the description of the previously-mentioned material. The paper concludes with an index and extensive bibliography.

M. E. M.

Zoophile and Anthrophile Races of Mosquitoes.—J. LEGENDRE ("La concurrence entre moustiques zoophiles et anthropophiles," *Compt. rend. des Séances de l'Acad. des Sci.*, 1929, 188, no. 1, 95-7). In a former communication the author has recounted his discovery at Portrieux (Côtes-du-Nord) of a race of *Culex pipiens* which avoided man (confining its attentions solely to animals), and his attempt to transport specimens of this race to Pons (Charente-Inferieure), where a race which attacked man existed, the object being to drive out the latter race by the former. In the present paper the results of this experiment, which was instigated in June, 1923, are given. It is stated that the attempt has been entirely successful, the inhabitants of certain farms formerly severely bitten by *Culex pipiens* now being quite unmolested. An account is given of a remarkable particular instance of the success of this experiment. A house which was severely troubled by a race of anthropophile *Culex pipiens* was found to have a tub in the garden where large numbers of these mosquitoes were breeding. The larvæ and pupæ in the tub were destroyed by emptying the water from the tub, which was then refilled with water to which were added larvæ of the zoophile race. As a consequence, this race became firmly established in the neighbourhood, and the inhabitants of the house were henceforth free from further attack.

M. E. M.

(NOTE.—From the reviewer's experience with this species it is considered doubtful whether there are, in fact, bionomically separate races of *Culex pipiens*. In England the species rarely attacks man, but occasionally in the autumn of warm years these mosquitoes will bite man viciously. They will, moreover, under particular conditions of humidity and temperature (*vide* Journ. Trop. Med. and Hyg., 1916, 19, 12, 142), feed on man with an avidity rivalling that of *Culex fatigans*.)

M. E. M.

The Respiration of the Larva of *Nymphula maculalis*.—P. S. WELCH and G. L. SEHON ("The Periodic Vibratory Movements of the Larva of *Nymphula maculalis* Clemens (*Lepidoptera*) and their Respiratory Significance," *Anns. Ento. Soc. America*, 1928, 21, no. 2, 243-58). Certain aquatic caterpillars regularly exhibit periodic vibratory movements of the anterior portion of the body, and, by inference, a respiratory function was assigned to them. The senior author (Welch, *ibid.*, 1916, 170-3; 1924, 398-9) has already described, among other things, the case-making

activities of the larva of *Nymphula maculalis* Clemens, and indicated a form of locomotion resulting from somewhat similar movements when the body is partly projected from detached cases. Performance of these movements both by larvæ wholly within cases—a position not related to any form of locomotion—was also observed, but not studied until recently. Some of the conclusions reached by the author in this investigation are as follows: the larvæ of *Nymphula maculalis* normally and regularly perform periodic, horizontal lashing movements of the anterior region at times when not engaged in other forms of body motions. These vibratory movements are independent of the regular activities of feeding, silk production, disposition of excreta and its disposal, and locomotion. The frequency of the vibration period increases with the rise in temperature within a range of about 4.5–30.5° C. Complete inhibition of movement occurs near 4.5° C., and as the temperature approaches about 30.5° C., the periodicity tends to give place to constant vibration and pathological conditions. In the normal leaf-cases these movements produce a definite current. Artificial current through the normal case produces distinct reduction of the vibration periods, and on further increase in rate of current they cease completely. When pieces of glass tubing were substituted for the normal cases, the vibratory movements were performed in much the usual fashion, and the production of water current was demonstrated. Increased exposure of the larvæ to the surrounding water, by the removal of one-half of its normal case, almost invariably eliminated the vibratory movements.* Reduction of dissolved oxygen in the surrounding water caused an increase in the frequency of the vibration periods: low quantities—below 1.0 c.c. per litre—tended to produce constant vibration. Immobilisation produces an inert condition in which the larvæ may exist for 80 or more hours, and recover when returned to the natural conditions. Available evidence indicates that the principal, if not the sole, function of these vibratory movements is to ensure the continued contact of the respiratory surfaces with a changed supply of amply oxygenated water. M. E. M.

Insect Nutrition and Metabolism.—B. P. UVAROV ("Insect Nutrition and Metabolism," *Trans. Ento. Soc. Lond.*, 1929, 76, pt. 2, 255–343). It is well known that the enormous losses regularly caused by insect pests to cultivated plants, domestic animals, and human life, are directly or indirectly connected with their feeding habits. On the other hand, the products of the few useful insects, like the honey-bee, silkworm, lac insect, etc., are, from the physiological point of view, substances of definite importance in the metabolism of the insects, and their quality and output depend on the character of the food taken. It would seem, therefore, that the problem of the nutrition and the metabolism of insects should be regarded as a key both to the successful control of injurious insects and to the progress of the industries dependent upon the products of useful insects. From this point of view, all the data on the chemical properties of the actual food of various insects, on the chemical constitution of insects, on the digestive enzymes, on the metabolism of the main substances, and of the influence of diets on the growth and reproduction of insects, have been collected in the form of a summary of the voluminous bibliography, including 600 titles. The author points out that his work is only a summary of published data, not a monograph on the subject, and that most of the data are presented without any attempt to criticise or to evaluate them. The summary should be regarded merely as a guide to the bibliography, arranged by subjects, and, as such, is a most valuable addition to the literature. The seven sections of this paper are: an Introduction, the Food of Insects, the Chemical Composition of Insects and their Products, Enzymes, Metabolism, the Influence of Diet on Growth and Reproduction, and the Biblio-

graphy. Owing to the fact that the bibliography extends from the year 1671 to the present, and to the fact that no attempt has been made to evaluate the data, the summary contains conflicting statements, and others which, in the light of modern investigations, are completely wrong. As a valuable and convenient reference to the reports of many investigators this paper will be found to be of inestimable help, but from this summary it would be unwise to form any definite conclusions, as apparently the author himself is well aware. M. E. M.

New Australian Mydaiidæ.—I. M. MACKERRAS ("New Australian *Mydaiidæ* (Diptera)," *Proc. Linn. Soc. N.S. Wales*, 1928, 53, pt. 5, no. 219, 537-43). Since the review of this family by Mr. G. H. Hardy (*ibid.*, 1925, 1, 139-44) five new species have been studied by the author and are here described. A key to the Australian species of the family, and notes on additional synonymy based on information received by Mr. Hardy from Major E. E. Austen, of the British Museum, are included. Nearly all the material comes from the Macleay Museum, University of Sydney, and the types of the new species will be lodged in that institution. It has been possible to recognise all the known species, with the exception of *Miltinus sordidus* Westw. The wing venation of the *Mydaiidæ* is rather complex, and is interesting in that the disposition of the branches of media is practically identical with that of the *Nemestrinidæ*. The "oblique vein" is present, and, but for the uniform presence of R-M, has practically the same constitution. It is, however, more irregular and more transverse in position. The media of *Trichophthalma* and *Nycterinyia*, figured in a previous paper (*ibid.*, 1925, 1, 495), fig. 3a, and 553, fig. 15b), correspond very well with that of *Dioclistus* and *Miltinus* respectively. While this resemblance is striking, the author considers that it cannot be used for phylogenetic purposes unless supported by other structural similarities. The length of the antennæ (principally of that part composed of the elongate third segment) offers a useful character for subdivision within the genera. These groups appear on other grounds to be natural ones, and the distinction between species with long antennæ and those with short antennæ is sharply defined in both genera, with the single exception of *Miltinus maculipennis* Westw., which is intermediate in structure, although apparently to be allied with the species with short antennæ, to which group *M. dentipennis* n. sp. also belongs. The following new species are described: *Dioclistus nicholsoni* n. sp., *Miltinus dentipennis* n. sp., *Miltinus musgravei* n. sp., *Miltinus tenuis* n. sp., *Miltinus minutus* n. sp. M. E. M.

Notes on Australian Diptera.—J. R. MALLOCH ("Notes on Australian Diptera, no. xvii," *Proc. Linn. Soc. N.S. Wales*, 1928, 53, pt. 5, no. 219). In this paper some data are offered upon a sub-family of *Mycetophilidæ*, notes on the genus *Pachyneres* Greene belonging to *Bombyliidæ*, a few notes on *Asilidæ*, and notes on some already described species of *Cyclorrhapha*, most of the latter being in extension of matter already published in a previous part of this series of papers. The data presented in this and other papers of this series have been acquired during the past quarter of a century in working over material from all parts of the world, and almost invariably are not available in published form in any journal either in Australia or elsewhere. *Calloplatyura* n. gen., *Nezplatyura* n. gen., *Xenoplatyura* n. gen., *Plecia* (*Plecia*) *bakeri* n. sp., *Plecia* (*Plecia*) *philippinensis* n. sp., *Plecia* (*Plecia*) *confusa* n. sp., *Plecia* (*Plecia*) *parva* n. sp., *Neoscleropogon* n. sub-gen. are the new genera, sub-genera, and species described, while identification keys are provided. M. E. M.

Notes on Australian Diptera.—J. R. MALLOCH ("Notes on Australian Diptera, no. xviii," *Proc. Linn. Soc. N.S. Wales*, 1928, **53**, pt. 5, no. 219, 651–62). The sub-title to this paper is "A Preliminary Catalogue of Australian Tachinidæ," and the author presents in alphabetical arrangement a catalogue of 88 genera and 228 species. M. E. M.

Mutable Characters of *Drosophila Virilis*.—M. DEMEREC ("Mutable Characters of *Drosophila virilis*. 1. Reddish-Alpha Body Character," *Genetics*, 1928, **13**, 359–88). In a preliminary report on the behaviour of the reddish body colour character (Demerec, 1926) it was suggested that the unusual results obtained in different experiments could readily be explained by the assumption that reddish frequently mutates to the wild type. This assumption has been made still more probable by the results obtained by recent studies on reddish. It is also supported by the work on the behaviour of the miniature-*a* wing character (Demerec, 1926) and the magenta-*a* eye colour character (Demerec, 1927), both of which revert in the same way as reddish. In the present paper an endeavour is made to give a detailed account of the results obtained only in the experiments with reddish. The details of the experiments with miniature-*a* and magenta-*a* will be presented in subsequent papers of the same series. Reddish-*a* was found in two sister matings in the back-cross involving the character branched as well as a concave approximated and telescoped. In one of the matings about one-half of the males were reddish, and in the other only one reddish male was found. The possibility is not excluded, but the probability is low, that the single male came as a contamination from the culture, which had many reddish males. Reddish-1 was found seventeen months later in a mating involving the same characters as the one in which reddish-*a* was found. The branched used in the second case had a different origin from the branched used in the first place, but the concave approximated telescoped flies came from the same line. To test the possibility that in the concave telescoped line mutations occur frequently, 16,980 offspring of the back-crosses, involving branched, approximated, and telescoped characters, were examined. No reddish flies were found. Both reddish-*a* and reddish-1 are sex-linked and allelomorphs of yellow. In F_2 generations from crosses from reddish-*a* and yellow, in addition to reddish-*a* and yellow flies, few wild-type ones appeared. Experiments indicate that these wild-type flies are not due to crossing over between reddish-*a* and yellow, that they are not due to the abnormal behaviour of chromosomes, nor to the complex genetic nature of reddish-*a*. They are interpreted as being reversions of the gene for reddish-*a* to the gene for wild-type. The wild-type flies which originated as reversions from reddish-*a* are genetically constant. Reddish-1 does not revert to wild-type. Reddish-*a* reverts to wild-type only in females which are heterozygous for reddish-*a* and one of its allelomorphs, namely, wild-type, yellow or reddish-1. No reversions were observed in somatic cells, in homozygous females or in the males. The frequency of reversions was found to be very variable. It decreased from 12.4 p.c. in the second generation after the origin of the reddish-*a*, to zero in the seventh generation. By using for mating flies from cultures which gave the highest number of reversions, it has been possible to keep the frequency of reversions for sixteen generations at about 3 p.c. A positive relation was found to exist between the mutability of the parent culture and the mutability of the offspring. A line was isolated in which reddish-*a* behaved as an almost constant character. The age of the female reduces the frequency of reversions. It was found that in the classes which originated by reversions the crossing over in the yellow-scutel region was increased 24 times over the normal amount. An analysis of the data indicates that the force which influences reddish-*a* to revert to the wild-type at

the same time causes the increase in the crossing over in the yellow-scutel region.
M. E. M.

A New Ornithodoros from the Algerian Sahara.—L. PARROT ("Un ornithodore nouveau du Sahara algérien, *Ornithodoros foleyi* n. sp.," *Bull. Soc. path. exot.*, 1928, **21**, 520-4, 5 text-figs.). The new species was found in the sand in the Algerian Sahara. It attacks man and the dromedary, and in general resembles *O. tholozani* and *O. canestrinii*, differing in the surface sculpture of the body in the form of the tarsi and of the first pair of coxæ, as well as in the form and dentition of the hypostome.
G. M. F.

Arthropoda.

Crustacea.

Secondary Sexual Characters of Crayfishes.—C. L. TURNER ("Studies on the Secondary Sexual Characters of Crayfishes. IX. Females of *Cambarus* with Aberrant Female Characters," *Biol. Bull.*, 1929, **56**, 1-7, 7 text-figs.). Aberrant females are rare in *Cambarus virilis* and *Cambarus propinquus*, only 20 cases being found in more than 15,000 females. When there are supernumerary oviducal pores in *Cambarus*, they are usually located on the second walking legs. This is in marked contrast to the condition in *Astacus*, where the supernumerary pores occur on the fourth or more rarely on the fifth walking leg.
G. M. F.

Trematoda.

A New Species of Trematode of the Genus Maritrema.—L. TRAVASSOS ("Une nouvelle espèce du genre *Maritrema*, *Maritrema pulcherrima* n. sp.," *Compt. rend. Soc. de biol.*, 1929, **100**, 945-6). This new species inhabits the small intestine of *Didelphis aurita* Wied. It was found in the state of Rio de Janeiro, Brazil.
G. M. F.

A New Species of Trematode of the Genus Pygidiopsis.—L. TRAVASSOS ("Une nouvelle espèce du genre *Pygidiopsis*, *Pygidiopsis pindoramensis* n. sp.," *Compt. rend. Soc. de biol.*, 1929, **100**, 956-7). This new species inhabits the intestine of *Ardetta erythramelas*, state of Rio de Janeiro.
G. M. F.

Cestoda.

New Intermediate Hosts of a Mouse Cestode.—F. LARROUSSE ("Hôtes intermédiaires nouveaux d'un cestode de la souris *Hymenolepis microstoma* (Dujardin, 1845)," *Compt. rend. Soc. de biol.*, 1929, **100**, 855-7, 1 text-fig.). Two species of coleoptera, *Gnathocerus cornutus* Fabr. and *Trogosita mauritanica* L., have been found to be natural intermediate hosts of the mouse cestode *Hymenolepis microstoma* in Strasbourg.
G. M. F.

Nematoda.

Filaridiæ from Batracians in Brazil.—L. TRAVASSOS ("Filaridés des batraciens du Brésil," *Compt. rend. Soc. de biol.*, 1929, **100**, 967-8). One species of filaria, *Foleyella convoluta* (Molin, 1858), had previously been described from the abdominal thoracic cavity of *Leptodactylus pentadactylus*. Two new species are now described, *F. scalaris*, from the sub-lingual connective tissue of *Leptodactylus ocellatus*, and *F. vellardi*, from the abdominal thoracic cavity of *Bufo marinus*.
G. M. F.

Strongyloides from the American Tapir.—L. TRAVASSOS ("Strongyloïdes de *Tapirus americanus*," *Compt. rend. Soc. de biol.*, 1929, 100, 962). The existence of two species of strongyloides from the American tapirs is confirmed. These species are of interest, since they are closely related to the strongyloides of elephants and rhinoceri.
G. M. F.

Rotatoria.

Rare Rotifers in Alsace.—P. DE BEAUCHAMP ("Formes rares des eaux douces d'Alsace," *Bull. Ass. philomath., Alsace Lorraine*, 1927, 8, 191-3). A short note records the occurrence in the vicinity of Strasburg of three forms described by American authors in recent years. The first, a volvocine, *Pleodorina californica* Shaw, had already been found by M. Chatton at Banyuls-sur-mer, and this is believed to be the only European record hitherto. In July, 1927, the author met with it in some numbers at Strasburg-Neudorf. The other two noteworthy forms are rotifers, viz., *Resticula gelida* and *Resticula nyssa*, both described by Harring and Myers in their "Rotifer Fauna of Wisconsin" (1922-24). So far as is yet known of its habits, *R. gelida* has the unusual characteristic of appearing only in the early spring, when the ice covering the winter pools is melting. Such again was the case when the author met with it in March, 1924, and also in March, 1925. Fadeev has recently reported its occurrence near Kharkow, in Russia. The closely-related *R. nyssa*, on the other hand, was met with in several collections both in spring and in autumn. This species does not seem to have been recorded for any European habitat until now.
D. B.

A New Rotifer Genus.—N. S. SMIRNOV (Leningrad) ("Fadeewella nov. gen., eine neue Rotatoriengattung aus dem Ussuri-Gebiet," *Zool. Anz.*, 1928, 79, 129-33, 4 text-figs.). In one of a series of plankton gatherings made in the Ussuri-Gebiet by the expedition of the Zoological Museum of the Academy of Sciences of U.S.S.R., the author has found many examples of a rather small rotifer belonging to the family of the Filiniidæ. As in the genus *Tetramastix*, there are four leaping-spines, but the posterior pair are placed laterally, not dorsally and ventrally respectively, as there. Further, the eyes are in the hinder end of the brain, not in the anterior part. For these reasons a new genus, *Fadeewella*, is created with the characters stated. In *F. minuta* sp. n. the leaping-spines are comparatively short, from 27μ to 39μ . The largest specimen seen measured in contracted condition only 69μ in length of body and contained a resting-egg.
D. B.

A Prolonged Study of the Life of a Rotifer.—H. S. JENNINGS and RUTH STOCKING LYNCH ("Age, Mortality, Fertility, and Individual Diversities in the Rotifer *Proales sordida* Gosse," 2 pts., *Journ. Exper. Zool.*, 1928, 50, 345-407, 13 text-figs.; 51, 339-81, 7 text-figs.). During the spring and summer or 1926 and the summer of 1927 the life-histories of 2,217 individuals of the oviparous rotifer *Proales sordida* Gosse, all derived parthenogenetically from one recent original ancestor, were studied under laboratory conditions, in several series termed "collections," with respect to their length of life, mortality, and fecundity, and with special regard to the relation of the age of the parent to these characteristics in the offspring. In nearly all cases the animals were cultivated separately on hollow-ground slides, each in a single drop of culture fluid and each transferred to a fresh drop day by day. For each individual was kept a record in which were noted the age of the parent when the egg was deposited (where, as usually, that was known), the size of the egg, the date and time of deposition and of hatching, the daily growth, the date of each deposition of a daughter-egg, and, after egg-laying ceased, any happening in later life until death. From the mass of data thus

obtained, numerous mortality, fecundity, and other charts and tables have been worked out. A remarkable variety of diversities was shown to exist among the individuals, notwithstanding their recent origin from a common ancestor. These diversities are attributed to the peculiarities of the germ cells from which the individuals arise, and these peculiarities appear to be matters of the cytoplasm, and to a certain extent quantitative in character, large germ cells producing individuals that differ characteristically from those arising from small germ cells. The differences thus far demonstrated lie in the diverse fecundity of the individuals and in the diverse length of the periods of embryonic life and of immaturity. The life-history is regarded as including four periods: (1) embryonic, from the deposition of the egg until it is hatched; (2) immaturity, before eggs are produced; (3) maturity, during which eggs are produced; (4) age, from the cessation of egg production until death. The first two periods lasted about 24 hours each, the third from 3 to 6 days, but the third showed great diversity in its duration. Individuals that survived the strain of the period of maturity and egg production may live for two or three times the total earlier life. The observed maximum of life was 23 days, the average being, however, only 8 or 9 days. When the individuals complete the period of fecundity, the number of eggs produced is usually from 24 to 28, with a maximum of 34. Only 10 individuals exceeded 32 eggs, 8 producing 33 and 2 producing 34 eggs. In eggs from old parents there was a high mortality during the embryonic period, but when the parents were young, a low one or none. In the period of immaturity there was practically no mortality. In the third period mortality increases, culminating within 24 hours of the end of the period, after which it declines and remains low. All the individuals of each collection were fed upon the same culture fluid. Of these fluids three were successively employed—infusions of the cereals rye, wheat, and oats respectively, the last of these giving the best results. It was prepared daily thus: boil $\frac{1}{4}$ gram (15 of the flattened flakes) of rolled oats ("Quaker Oats") for three minutes in 100 c.c. of spring water, filter and allow to stand for 24 hours before using. The study here presented is to be followed by other studies, on the same species, of the factors at work in relation to the typical life-history, to environmental conditions, and to other matters. When these, and especially that relating to the typical life-history, are finished, one would be able to estimate more nearly how far the results now detailed are consequent upon the special food and the protected conditions of life in a laboratory.

D. B.

Protozoa.

Anomalies in *Trypanosoma lewisi*.—G. LAVIER ("Sur quelques anomalies chez *Trypanosoma lewisi*," *Compt. rend Soc. de biol.* 1929, **100**, 875-6). Although it is not uncommon to find specimens of *T. lewisi* deprived of a nucleus, the absence of the parabasal body is rare. Only three instances have been met with out of some thousands of trypanosomes examined.

G. M. F.

Types of *Elphidium* (= *Polystomella*).—J. A. CUSHMAN and D. H. LEAVITT ("On *Elphidium macellum* (F. & M.), *E. striatopunctatum* (F. & M.), and *E. crispum* (Linné)," *Cont. Cushman Lab. Foram. Research*, 1929, **5**, no. 73, 18-22, pl. iv). The tendency to take up a later author's idea of a species, without reference to the original description and figures, is nowhere more strikingly illustrated than in this group. In order to fix as accurately as possible what should be taken as the typical form for each of these three species, the authors reproduce the original figures of Fichtel and Moll, and give drawings of specimens considered typical from as near the type locality as obtainable. It is clear that the *Polystomella striato-*

punctata of most, if not all, authors since the time of Fichtel and Moll is not the same species as that of the original authors, which appears to be confined to the very warm shallow waters of the Red Sea and Indian Ocean. A. E.

Californian Discocyclinae.—H. G. SCHENK ("Discocyclina in California," *Trans. San Diego Soc. Nat. Hist.*, 1929, 5, no. 14, 211–40, pls. 27–30, figs. 1–40). An exhaustive study of the Californian species in comparison with the generic type *D. pratti* (Michelin). Two species, *D. clarki* (Cushman) and *D. californica* Schenck sp. nov., are dealt with fully, a third species remaining indeterminate for want of suitable material. The paper is elaborately illustrated, and also contains a useful bibliography of the literature of the group. A. E.

More New Species.—J. A. CUSHMAN and P. W. JARVIS ("New Foraminifera from Trinidad," *Cont. Cushman Lab. Foram. Research*, 1929, 5, no. 72, 6–17, pls. 2–3). Twenty-one new species and varieties from fossil material collected in Trinidad by Mr. Jarvis are figured and described in advance of the publication of a description of the entire faunas. Several of them appear to be old friends passing under new names. A. E.

Foraminifera of London Clay.—A. G. DAVIS ("The Geology of the City and South London Railway Clapham-Morden Extension," *Proc. Geol. Assoc.*, 1928, 39, 339–52). Sixty-seven species and varieties are recorded from material collected from various horizons during the excavations. They include *Spiroloculina tenuis* (Czjzck) and *Ramulina cervicornis* (Chapman), which have not previously been recorded from the London clay. The paper includes valuable information as to the zonal distribution of the foraminifera and other organisms. A. E.

Discovery of Cycloloculina in America.—J. A. CUSHMAN ("Cycloloculina in the Western Hemisphere," *Cont. Cushman Lab. Foram. Research*, 1929, 5, no. 71, 4–5, figs. 8–10 on pl. 1). *Cycloloculina* H. A. and E. was first described in this Journal in 1908 (pp. 529–43, pl. xii) from the Eocene of Selsey, and has since been recorded from beds of similar age at Paris and Biarritz. A closely-allied genus, *Sherbornina* Chapman, occurs only in the Miocene of Tasmania. Both are very rare. A new species, *Cycloloculina jarvisi*, is now described from Eocene deposits in Trinidad, which marks the first appearance of the group in the New World. In the Trinidad species the annular chambers are more numerous and closer together than in the English species, and the early coiled chambers more elongate and narrower. There is no sign of the spinose periphery marking *C. annulata*. The Trinidad specimens were possibly attached, as the wall on one side of the shell is flatter and thinner than on the other. The figures are very weak. A. E.

New Genus from Cretaceous of Texas.—J. A. CUSHMAN ("Kypophyxa, a New Genus from the Cretaceous of Texas," *Cont. Cushman Lab. Foram. Research*, 1929, 5, no. 70, 1–4, figs. 1–7 on pl. 1). *Kypophyxa* may be described as a Flabelline *Fronicularia* in which the latter chambers meet and overlap round the base of the shell. It was originally described by Carsey in 1926 as *Fronicularia christneri*, and is one of the common species of the Upper Cretaceous of Texas. At the height of its development it was widely distributed in Texas, Arkansas and Florida, and often very abundant, but rapidly became extinct. A. E.

Structure and Relations of Textularia siphonifera Brady.—J. A. CUSHMAN ("Fistulose Species of *Gaudryina* and *Heterostomella*," *Cont. Cushman Lab. Foram. Research*, 1928, 4, no. 68, 107–12, pl. 16). The initial chambers of Brady's species are triserial, and it should therefore be transferred to *Gaudryina*.

With the exception of one record from the Gulf of Suez, it appears to be confined to the tropical Indo-Pacific region, and it is likely to be confused with a true *Textularia* which has been erroneously recorded, under Brady's name, from Samoa by Cushman and from Balcombian strata in Australia by Chapman. Fistulose *Gaudryinae* occur in the Cretaceous of Europe and America, and the author regards them as a development of the sharply-angled forms of *Gaudryina* found in the same deposits. *Gaudryina stephensoni*, a new species from the Upper Cretaceous of Texas, illustrating such fistulose development, is described and figured. A. E.

A Study of a Type.—J. A. CUSHMAN ("On *Rotalia beccarii* (Linné)," *Cont. Cushman Lab. Foram. Research*, 1928, 4, no. 67, 103-7, pl. 15). Many of the older species were so feebly described and illustrated that they are imperfectly understood. Instead of going back to the earlier figures and type specimens, or studying topotype material, many workers have followed figures given by later authors which are not typical, and so confusion has arisen. The author has been studying some of the older collections and collecting material from localities, such as Rimini and Coroncina, favoured by early writers, with the view of establishing the true types of some common species. The *Nautilus beccarii* of Linné was based on a drawing in Plancus's "De conchis minus notis" (1739), and the author reproduces the original illustration and also figures a series of specimens collected by himself at Rimini, the locality given by Plancus. He comments on the differences between these figures and those given by many later authors, and expresses the opinion that the true *R. beccarii* is not a species of universal distribution, as generally stated, but one confined to a rather restricted area, and that numerous varieties or species hitherto recorded under that name will be found to have definite local distributions. A. E.

Cretaceous Foraminifera from Trinidad.—J. A. CUSHMAN and P. W. JARVIS ("Cretaceous Foraminifera from Trinidad," *Cont. Cushman Lab. Foram. Research*, 1928, 4, 66, 85-103, pls. 12-14). A preliminary account of recently collected material of Upper Cretaceous origin. The specimens are from clays in which the colour and material of the shell wall are usually very well preserved. The collections are regarded as of particular interest as contemporary with the Velasco shale of Tampico, Mexico, and the superior preservation of the Trinidad specimens throws light on the finer structures of some of the Mexican species. Both faunas represent an off-shore assemblage of species favouring considerable depth, but the prevalence of arenaceous genera in the Trinidad gatherings indicates even deeper water than in the Mexican shales. Many of the species are identical with or closely related to species now found in adjacent areas in comparatively deep water. Ten new species or varieties are described. The figures are good. A. E.

BOTANY.

(Under the direction of A. B. RENDLE, D.Sc., F.R.S.)

GENERAL.

Cytology.

Nicotiana Hybrids.—T. H. GOODSPEED and R. E. CLAUSEN ("Interspecific Hybridization in Nicotiana. VIII. The Sylvestris-Tomentosa-Tabacum Hybrid Triangle and its Bearing on the Origin of Tabacum," *Univ. Calif. Pub. Bot.*, 1928, 11, 245-56). The species *sylvestris*, *tomentosa*, and *tabacum* and the three possible hybrids F_1 *sylvestris-tabacum*, F_1 *tomentosa-tabacum*, and F_1 *sylvestris-tomentosa*, have been cytologically examined. Such a series is called a hybrid triangle. In morphology the *sylvestris-tabacum* hybrids show a marked resemblance to the *tabacum* parent, while the other hybrids of the triangle show mainly a synthesis of the characteristic features of their respective parental species. Both *sylvestris-tabacum* and *tomentosa-tabacum* hybrids show 12 bivalent and 12 univalent chromosomes at diakinesis and heterotypic metaphase, though the subsequent behaviour of the chromosomes differs in the two types. These hybrids do not set seed on self-fertilisation, but display partial fertility when back-crossed to the parental species. The *sylvestris-tomentosa* hybrids have 24 univalent chromosomes at diakinesis and metaphase. Normally no division of these univalents occurs. Dyad formation is of frequent occurrence. So far no fertile seed has been obtained either by selfing the hybrid or back-crossing to the parents. From the fact that *sylvestris* and *tomentosa* have distinct morphological differences, and that both *tabacum* haplont and *sylvestris-tomentosa* typically show no pairing of chromosomes, it is assumed that *tabacum* possesses two sets of chromosomes, one homologous with that of *sylvestris*, the other with that of *tomentosa*, and, further, that its progenitor arose through hybridisation of two species, progenitors or close allies to *sylvestris* and *tomentosa*, followed by a doubling of chromosome number.

J. L.

Chromosomes in Nicotiana.—M. L. RUTTLE ("Chromosome Number and Morphology in Nicotiana. II. Diploidy and Partial Diploidy in Root-Tips of Tabacum Haploids," *Univ. Calif. Pub. Bot.*, 1928, 11, 213-32). In *Nicotiana* cultures haploid plants are known to have occurred as follows: one *tabacum* var. *purpurea* in an F_1 *purpurea-sylvestris* of 58 plants; one *tabacum* var. *macrophylla* in an F_1 *macrophylla-sylvestris* of 50 plants; two *tabacum* var. *purpurea* in an F_1 *purpurea-sylvestris* of 590 plants; one *tabacum* var. *purpurea* in an F_1 *purpurea-tomentosa* of 26 plants; two *tabacum* var. "Cuba" in an F_1 *Cuba-sylvestris* of 320 plants. The haploids are replicas on a reduced scale of their particular *tabacum* parent. Root-tips of the five last-mentioned are used in the present study. The somatic chromosome number of these haploids is 24. These chromosomes show size differences, and at least two are satellited. The chromosomal

complexes of the *purpurea* and Cuba haploids are indistinguishable. A large number of root-tips from these haploid plants are partially or wholly diploid, 22 out of 82 showing complete diploidy, while 8 contain both haploid and diploid cells. The origin of this diploid condition was not observed, but nuclear fusion is suggested by the occasional occurrence of a large and irregular-shaped diploid nucleus. In the partially diploid root-tips the diploid area varies considerably in size, and is extremely irregular in cross-section. Cell-size is not always proportional to chromosome number, though, on the average, the diploid are slightly larger than the haploid cells. At present no tetraploidy is known to occur in root-tips of diploid plants. Diploidy in haploid plants is not found in archesporial tissue either of microspores or megaspores, but is apparently limited to the root-tips.

J. L.

Chromosomal Vesicles in Plant Nuclei.—J. MCA. KATER ("Reconstruction of Daughter-Nuclei and the Individuality of Chromosomal Vesicles During Interkinesis," *Q.J.M.S.*, 1928, **72**, 189–217). The reconstruction of daughter-nuclei has been investigated in the root-tips of *Solanum tuberosum*, *Lycopersicon esculentum* and *Allium Cepa*, which have respectively very small, medium, and very large chromosomes. The method of reconstruction is by vesiculation of contiguous chromosomes. This alveolisation of the chromosomes is caused by imbibition of achromatin from the cytoplasm, which process is probably an osmotic phenomenon. The achromatin first appears as small scattered globules which increase in number until the interior of the chromosome, now a chromosomal vesicle, becomes a network of chromatin enmeshing spherules of achromatin. This process of alveolisation brings into evidence a thin sheath of material bounding the vesicle. These sheaths consist of linin, and remain unaltered through the alveolisation process except for becoming distended. When in contact with the cytoplasm they give rise to the nuclear membrane. The chromosomes, therefore, are not separated by achromatic channels which are bridged by anastomosing connections from the chromosomes, but the achromatin is present inside the contiguous linin sheaths of the chromosomal vesicles. The nucleolus is derived from the chromosomes by the union of non-alveolised chromatin masses, and the vesicles become arranged so that their sheaths radiate about the nucleolus. The integrity of the chromosomal vesicles is maintained during interkinesis, and a prophase chromosome is formed in each vesicle before its walls disappear. The exact origin of the chromosomal sheath is as yet obscure.

J. L.

A Tetrapartite Sex Chromosome.—Y. SINOTO ("On the Tetrapartite Chromosome in *Humulus Lupulus*," *Proc. Imp. Acad., Tokyo*, 1929, **5**, 46–7). The chromosome numbers of *Humulus Lupulus* are 10 haploid and 20 diploid. In the heterotypic division of the pollen mother-cells eight gemini and a string of four univalent chromosomes are present. A side view of the nuclear figure shows the members of this tetrapartite chromosome arranged in a zigzag or N shape. The two middle chromosomes are equal in size and larger than the two end ones, which differ in size from one another. This tetrapartite chromosome is considered to be a new type of sex chromosome. The formulæ of the chromosomal condition of *H. Lupulus* are given as follows: ♂ diploid = $16 + X_1Y_1X_2Y_2$, ♂ haploid = $8 + X_1X_2$, ♀ diploid = $16 + X_1X_2X_2X_1$, ♀ haploid = $8 + X_1X_2$.

J. L.

Meiosis in Tropaeolum.—T. SUGIURA ("Cytological Studies on Tropaeolum. II. *Tropaeolum peregrinum*" *Bot. Mag., Tokyo*, 1928, **42**, 553–6). The chromosome numbers for *Tropaeolum peregrinum* are 12 haploid and 24 diploid

as compared with 28 diploid for *T. majus*. Nucleolar budding is conspicuous in the heterotypic prophase of the pollen mother-cells. After second contraction these buds are hard to observe. It is considered probable that these buds supply material for chromosome formation. The method of chromosome pairing is telosynaptic. An aggregation of granules is present in the equatorial zone at heterotypic telophase. These granules disappear at the homotypic division, and quadripartition of the cell is brought about by protoplasmic furrowing.

J. L.

Chromosomes in Zea.—L. F. RANDOLPH ("Chromosome Numbers in *Zea Mays*," *Memoir* 117, *Cornell Univ. Agri. Exper. Station*, June, 1928). Cytological studies were made of several commercial varieties of dent, flint, pop and sugary maize, and a number of genetical types. The meiotic chromosome number was determined for 338 plants; 200 of these had the diploid number 20, while the remainder (from 4 commercial varieties and 7 genetical cultures) had chromosome numbers varying from 21 to 28. No deviations from the typical chromosome number were found to occur in varieties of dent maize or pop corn. Among the genetical types, plants with extra chromosomes occurred in both self-fertilised and cross-pollinated cultures. Widely different chromosome numbers occurred in the progeny of plants which had been self-fertilised for several generations. The number of chromosomes was usually constant in different pollen mother-cells of individual plants, and always constant in the different cells of the same or different root-tips of individual plants. The numbers present in the root-tip cells did not always, however, correspond to the number present in the sporocytes. Two plants out of 31 examined showed the somatic number greater than twice the meiotic number of chromosomes. The chromosomes of the typical set regularly formed ten bivalents at diakinesis, and showed no meiotic irregularities. Size variations were observed among the chromosomes, but the existence of distinct size classes could not be ascertained. Significant differences in the lengths of the members of individual bivalents were not apparent. The plants with more than 20 chromosomes had ten bivalents closely resembling in appearance and meiotic behaviour those of the typical set, and, in addition, extra chromosomes of unusual form and deeper staining capacity. During diakinesis and heterotypic metaphase the extra chromosomes were usually quite independent of the ten bivalents. Great variability was shown in the manner of association of these extra univalents among themselves during these stages, and their subsequent distribution in both heterotypic and homotypic divisions was very irregular. The 20-chromosome plants and those containing extra chromosomes showed a similar variation in chromosome size. The extra chromosomes were approximately the same size as the shortest member of the typical set. These observations are followed by a discussion on the possible rôle of segmentation, fusion, duplication and hybridisation in relation to the origin of the extra chromosomes. Further studies are necessary before definite conclusions may be drawn as to the nature of these additional chromosomes of *Zea*.

J. L.

Chromosome Numbers in Some Higher Plants.—T. SUGIURA ("Chromosome Numbers in Some Higher Plants," *Bot. Mag., Tokyo*, 1928, 42, 504-6). The following chromosome numbers have been determined: *Calceolaria mexicana* $n = 30$, *Daphniphyllum macropodum* $n = 16$, *Nemophila insignis* $n = 9$, *N. maculata* $n = 9$, *N. discoidalis* $n = 9$, *Phacelia congesta* $n = 9$, *Pleuropterypyrum Weyrichii* $n = 10$, *Persicaria perfoliata* $2n = 22$, *P. Thunbergii* $2n = \text{ca. } 34$, *P. glandulosa* $2n = 22$, *Amblygonon orientale* $2n = 22$, *Primula malacoides* $n = 9$, *P. Forbesii* $n = 9$, *Zingiber officinale* $2n = 22$, *Epipactis falcata* $2n = 24$. Cyto-

kinesis has been studied in all but the last two species. In each case pollen formation is brought about by means of protoplasmic furrowing. J. L.

Chromosomes in Polyploid Wheat Hybrids.—H. KIHARA and I. NISHIYAMA ("New Aspects of Chromosome Behaviour in Pollen Mother-Cells of Tri-, Tetra- and Pentaploid Wheat Hybrids," *Bot. Mag., Tokyo*, 1928, **42**, 221-31, Japanese with English summary). The triploid wheat hybrids *Triticum dicoccum* ♀ × *T. monococcum* ♂ and *T. aestivoides baoticum* ♀ × *T. dicoccum* ♂ show in addition to the usual chromosome combination $7_{II} + 7_I$, a range of from 1-3 trivalents associated with a varying number of bivalents and univalents. A tetrapartite chromosome is occasionally observed. A similar variation in bivalents and trivalents occurs in the tetraploid hybrid *T. Spelta* × *T. aestivoides baoticum* as well as the normal $7_{II} + 14_I$. The normal chromosome combination $14_{II} + 7_I$ occurs in nearly every case examined of the pentaploid hybrid *T. durum* × *T. vulgare*. One or two trivalents are rarely seen. J. L.

Osmic Impregnation Methods.—ROBERT H. BOWEN ("The Use of Osmic Impregnation Methods in Plant Cytology," *Bull. Torrey Bot. Club*, 1929, **56**, 33-51). Full details are given of the technique of osmic impregnation by the methods of Kolatchev, Hirschler, and Weigl, followed by details for bleaching and counter-staining osmicated material. The characteristic appearance of sections from material prepared by any of the osmic methods is as follows: the impregnated structures are an intense black with the background yellowish or colourless, the nucleus is easily distinguishable, the chromosomes in division stages are only seen with difficulty, and the cell-walls may or may not be sharply delimited. The results are very variable; even in adjacent cells the elements impregnated will be different. The "osmiophilic platelets" in the cytoplasm are regularly blackened, and can be demonstrated only by osmic impregnation methods. The plastidome (primordial bodies from which plastids develop, and fully differentiated plastids) may be blackened alone or simultaneously with the platelets. Blackening of the vacuome depends largely upon its contents. The chondriosomes (pseudochondriome) are the least commonly blackened cytoplasmic elements. In cells undergoing mitosis other impregnated elements are distinguished, including polar caps and spindle fibres. The whole history of the division figure can be followed, though the nucleus itself is not often impregnated. Very commonly there is intense blackening of bodies within the cell vacuoles. The "osmiophilic platelets" are considered to be the homologue in plant cells of the animal Golgi apparatus. It is suggested that the anomalous results obtained by Guilliermond are due to considerable differences in technique. J. L.

Cytoplasmic Inclusions.—RUTH PATTEN, MARGARET SCOTT, and J. BRONTË GATENBY ("The Cytoplasmic Inclusions of Certain Plant-Cells," *Q.J.M.S.*, 1928, **72**, 387-401). The material used in the present study consisted of root-tips of *Vicia* and *Hyacinthus* and shoots of *Pisum*. Full details are given of the technique of the Kolatchev and Weigl osmic acid methods and the following cell inclusions of the Kolatchev material are described, viz., mitochondria, plastids and osmiophilic platelets. These platelets constitute the "Golgi elements" of the plant cell. They are very small discs appearing as a black line when seen edge on, and display very little size variation in the plants studied. They have not been demonstrated by other Golgi methods nor observed in living material. The authors claim that there is no evidence that the vacuolar spaces of plant cells form a self-perpetuating "system," or are possessed of a lipoid membrane, or are associated with the Golgi elements. J. L.

The Vacuome of Plant-Cells.—A. GUILLIERMOND ("The Recent Development of Our Idea of the Vacuome of Plant-Cells," *Am. Journ. Bot.*, 1929, **16**, 1-22). A brief account is given of the researches of P. A. Dangeard on the origin of vacuoles. Dangeard termed the whole system of vacuoles in any given cell, at any stage, the *vacuome*. In its first stages the vacuome appears as small threads which resemble mitochondria. These threads consist of a very thick colloidal solution of metachromatin, and, on absorbing water, swell to become conspicuous vacuoles. Metachromatic granules, so frequently seen in these vacuoles, result from the throwing down of the metachromatin from its colloidal state by the action of the intravital dyes or killing fluids. These results have been checked by the present author, who also puts forward evidence from staining reactions that the chondriome and vacuome represent distinct systems at all stages of development. The vacuome cannot be stained by mitochondrial methods, and such intravital dyes as neutral red, which are readily absorbed by the vacuome, do not stain the chondriome. The development of the vacuome is similar in cells of flowering plants and fungal hyphæ, but staining reactions show the colloidal matter of the vacuome of the higher plants to be protein or phenol compounds and not metachromatin. The mitochondria-like bodies from which the vacuoles originate have been observed in living unstained material. The granules which are thrown down from the colloidal solution are sometimes projected out of the vacuole into the adjoining cytoplasm. In maturing seeds large vacuoles become small and filiform by dehydration and ultimately shrink to solid protein aleurone grains which do not stain with intravital dyes. On germination, hydration brings about the reverse process. According to its state of hydration, the vacuome can therefore exist as (1) solid bodies, or (2) a mitochondrial-like network of colloidal solution, or (3) ordinary liquid vacuoles. Vacuoles can arise either *de novo* in the cytoplasm or from pre-existing vacuoles. By different methods of technique the vacuome network has been demonstrated to be the same constituent of the cell as the Holmgren canals and Golgi apparatus of the animal cell. J. L.

Anatomy and Histology.

Wood Structure of the Araucariaceæ.—D. J. W. POOL ("On the Anatomy of Araucarian Wood," *Receuil des travaux bot. néerlandais*, 1929, **25**, 3 and 4, 484-620, 81 figs.). The author's aim has been to provide precise anatomical descriptions of the secondary xylem, and as far as possible the primary xylem, of all available species of the family. Eight species of *Araucaria* and two species of *Dammara* are described, namely, *Araucaria araucana* Koch, *A. Bidwillii* Hook., *A. angustifolia* Bertoloni, *A. Cunninghamii* Sweet, *A. excelsa* R. Br., *A. Cookii* R. Br., *A. Rulei* F. Muell., *Araucaria* species, *Dammara alba* Lam. (*Agathis alba*), *D. australis* Lamb. (*Agathis australis*). The descriptions are in some detail and are modelled on those of Moll and Janssonius. The wood of each species of *Araucaria* is described and the characters common to the genus are summarised separately. Ray tracheids, not hitherto reported in this family, were observed in several species of *Araucaria*. They occur only in rays in the neighbourhood of leaf-traces. No striking differences between the various species were observed. They might be divided into two groups according to the presence or absence of biseriate rays. These groups agree roughly with the division which has been made on a morphological basis. A tentative key to the identification of the species is given. The family is characterised by having the pits on the radial walls of the tracheids contiguous. This feature is believed to be of greater significance than the arrangement of the pits in several rows. Undue systematic importance

has been attached to the presence of resin-plates in the tracheids; they are not invariably present, the resin being sometimes replaced by starch in the ray-cells. Wood-parenchyma in *Araucaria* is limited to the root and to the first few rings of the stem. In *Dammara* it is of more general occurrence. Biseriate rays occur in both genera, but are of local occurrence only. Upright ray-cells are confined to the roots and to the primary wood and first few rings of the stem.

B. J. R.

CRYPTOGAMS.

Pteridophyta.

Leptochilus.—EDWIN BINGHAM COPELAND ("Leptochilus and Genera Confused with it," *Philippine Journal of Science*, 1928, 37, 333-416, 32 plates, 52 figs.). A careful investigation of the ferns which have been wrongly referred to *Leptochilus* in standard works, and a rearrangement of them under six genera—*Leptochilus* (2 species), *Christiopteris* (described and monographed in 1917), *Lomagramma* (5 species), *Campium* (56 species), *Hemigramma* (7 species), and *Quercifilix* (a new genus with one species). It is suggested that *Hemigramma* is of kin with *Tectaria*, *Christiopteris* with *Matonia*, *Lomagramma* with *Dennstaedtia*, while *Leptochilus* appears to be related to *Phymatodes*, to the group of *P. myriocarpa*. The genus *Campium* was created by Presl in 1836; it is a Polypodioid genus descended from *Colysis*, a section of *Sellignea*, and in the present monograph it consists of two sections—*Dendroglossa*, with simple entire fronds, and *Heteroneuron*, a much larger section, with fronds pinnate or with main veins conspicuous. All the new species are included in the numerous plates, and the abundance of text-figures is of great help for the right determination of species which have been much confused in the past.

A. G.

Chinese Ferns.—HEINRICH HANDEL-MAZZETTI ("Symbolæ Sinicæ. Botanische Ergebnisse der Expedition der Akademie der Wissenschaften in Wien nach Südwest-China 1914-1918," VI. Teil. Pteridophyta, Wien 1929, 1-53, 2 plates). An account of the ferns collected by the author during an expedition to south-west China in 1914-18. It comprises a total of over 250 species and some varieties, including descriptions of 17 species new to science. In all, 36 species are added to the fern flora previously recorded for China.

A. G.

Bryophyta.

Sphærothecium.—R. S. WILLIAMS ("Sphærothecium Hampe—a good genus," *Bryologist*, 1928, 31, 72-3, 1 pl.). A description and figures of a moss collected in New Granada by Lindig and defined by Hampe. It is related to *Campylopus*. Owing to a change of specific name, it was at one time confounded with a Javan moss. It now stands as *Sphærothecium phascodeum*. Mitten added to the genus another species, found in Ceylon.

A. G.

Moss Anomalies.—N. ARNANDAU ("Bryologische Mitteilungen," *Bull. Soc. Bot. de Bulgarie, Sofia*, 1926, 1, 37-42, 3 figs.). In a wet culture of *Catharinea undulata* in winter the resting branch-buds were seen to put out remarkable leaves with the costa well developed, but with the lamina reduced almost to nothing and the lamellæ absent. Another anomaly observed in the same species was that after premature removal of the calyptra very dwarfed sporogonia were formed, which, however, reached a condition of full maturity. In *Dicranum scoparium* protonemal filaments were observed to arise from the torn edge of calyptras cultivated in

moisture. In this species a double capsule was found in a normal tuft of the plant. The author is of opinion that it arose from a single egg-cell, but that, owing to some accident in development, two growing points were formed on the embryo. A. G.

British Mosses.—D. A. JONES and OTHERS (*The British Bryological Society Report for 1928*, 2, pt. 2, *Berwick-upon-Tweed*, 1929, 73–141). An enumeration of the mosses and hepatics collected by the members of the Society during 1928, with frequent critical notes on the specimens. A most interesting addition to the British flora is the moss *Ceratodon chloropus* Brid., recently detected by the Rev. C. H. Binstead in Somerset. This species of Mediterranean type has hitherto eluded detection in our islands. A useful bibliography of bryological papers published during the year is appended. A. G.

Greenland Mosses.—H. N. DIXON ("Notes on the Mosses of the Oxford University Expedition to West Greenland, 1928," *Bryologist*, 1929, 32, 1–3). A collection of about 150 samples was made near Iseriutilik, on the west coast of Greenland, lat. 64° N. The common Greenland mosses are omitted from the list, mention being made only of the more interesting species, 11 in number. One of these is *Bryum oroniense*, a very small and distinct plant, new to science, and related probably to *B. aquatense* Thér. and *B. brachyneuron* Kindb. A. G.

Mosses of Portugal.—ANTÓNIO LUÍS MACHADO GUIMARÃES, ("Sinopse das briófitas de Portugal," *Boletim da Sociedade Broteriana, Coimbra*, 1928, 5, (II série), 104–226). An instalment of the moss flora of Portugal, including the Fissidentales, Dicranales, Pottiales, with a general key and keys to the genera and species. Each species is described, its distribution in Portugal is stated, and critical notes are added, as well as references to literature. A. G.

Canadian Hepatics.—A. H. BRINKMAN ("Notes on Some Canadian Hepatics," *Bryologist*, 1928, 31, 75–83). In revising the hepaticæ of the Ottawa Museum, some points of interest were observed. For instance, in *Pellia* it was found that the brown thickened bands in the thallus of *P. epiphylla* and *P. Neesiana* may be defined as strengthening tubular cells which range in colour from hyaline to a deep reddish brown. In *Marsupella* the three species, *sphacelata*, *Sullivantii*, *sparsifolia*, seem to graduate into one another, and *M. Pearsoni* and *M. aquatica* are difficult to distinguish from some variants of *M. emarginata*. In *Gymnomitrium* the three species, *coralloides*, *obtusum*, *concinnum*, approach each other in certain directions. A. G.

Texas Mosses.—EDWIN B. BARTRAM ("Mosses from Western Texas collected by Mr. C. R. Orcutt," *Bryologist*, 1929, 32, 7–11, 1 pl.). A list of 30 mosses collected in early summer, in western Texas, which reveals the striking difference between the moss flora of the south-western States and the far better known flora of the northern and eastern States. A new species, *Grimmia (Gasterogrimmia) americana*, is described and figured. A. G.

Chinese Mosses.—VIKTOR F. BROTHÉRUS ("Symbolæ Sinicæ. Botanische Ergebnisse der Expedition der Akademie der Wissenschaften in Wien nach Südwest-China, 1914–1918, herausgegeben von Heinrich Handel-Mazzetti," IV. Teil. Musci, Wien, 1929, i–v, 1–147, 5 pls.). An account of the mosses collected by H. Handel-Mazzetti during an expedition to S.W. China in 1914–18, comprising nearly 1,500 specimens, which were worked out by the late V. F. Brotherus not long before his death. The list contains 217 genera (10 of which are endemic and 9 are new to science) and 612 species. Of these latter as many as

235 are described for the first time. The provinces explored were Yun-nan, Kwei-Chou, S.W. Sze-chuen, Hou-nan, Kiang-si, and Fo-kien (the two latter by a native collector). In the plates 42 species are figured. A. G.

New Zealand Mosses.—H. N. DIXON ("Studies in the Bryology of New Zealand, pt. vi," *N.Z. Inst. Bull.* no. 3, *Wellington*, 1929, 299–372, i–xviii, 1 pl.). This moss flora, largely founded on the collections of the New Zealander Robert Brown, is brought to an end with the present part, which contains an index to the whole work and some pages of addenda. There is also a list of the new species (26) and varieties (6) described in the work. Keys to the genera and species, critical and historical notes, and references to literature, are provided in the text, and the completed volume supplies to bryologists a convenient synopsis of what is now known of the moss flora of New Zealand. A. G.

Thallophyta.

Algæ.

Phytoplankton of Arizona.—WM. R. TAYLOR and H. S. COLTON ("The Phytoplankton of Some Arizona Pools and Lakes," *Amer. Journ. Bot.*, 1928, 15, 596–614, 2 pls.). An account of the algæ collected in Coconino County, Arizona, by H. S. Colton in the summers of 1923 and 1925 when searching for entomostraca. Almost nothing was known previously of the freshwater algæ of that part of the United States in which Arizona lies. The present enumeration includes about 80 species, without any account of the diatoms. The geographical nature and ecological conditions of the district explored are discussed. A. G.

Blue-Green Algal Marl.—ALFRED P. DACHNOWSKI-STOKES and R. V. ALLISON ("A Preliminary Note on Blue-Green Algal Marl in Southern Florida in Relation to the Problem of Coastal Subsidence," *Journ. Wash. Acad. Sci.*, 1928, 18, 476–80, 2 figs.). In southern Florida there are wide expanses of marshy grey marl, 1 to 2 ft. thick, covering the limestone bedrock. This marl is peculiar in that it is being built up mainly by blue-green algæ. Evidence is accumulating to show that bacteria and blue-green algæ act on a large scale as builders of mineral soil by causing the precipitation of calcium, silicon, iron, sulphur, and colloidal organic material. Bacteria are associated with the accumulations of calcareous sediments and oolites in shallow sea-water adjacent to the coral reefs of Florida and the Bahamas. In the grey marl of Florida species of *Scytonema*, *Calothrix*, *Lyngbya* and *Dichothrix* are found to form a thin, soft, greenish-blue matted coating closely attached to the friable calcareous material, 1 or 2 in. below the surface. They form grey, laminated or flaky and nodular incrustations, with porose structure down to a depth of 5 to 8 in. Underneath is greyish-white compacted harder marl, amorphous, plastic (when wet), dark grey in colour, and reaching down to the limestone bedrock. On the surface grow evergreen trees, with sedges, grasses, reeds, etc. A. G.

Algæ of Iceland.—JOHS. BOYE PETERSEN ("The Freshwater Cyanophyceæ of Iceland," *The Botany of Iceland, Copenhagen*, 1923, 2, pt. ii, no. 7, 249–324, 17 figs.). A monograph of the blue-green algæ of Iceland, with their distribution on the island. It contains numerous critical notes and a bibliography. A. G.

Algæ of Iceland.—JOHS. BOYE PETERSEN ("The Aerial Algæ of Iceland," *The Botany of Iceland, Copenhagen*, 1928, 2, pt. ii, no. 8, 325–447, 36 figs.). A treatise on the aerial algæ of Iceland based exclusively on the collections made by

the author in 1914, giving a list of the contents of each of 410 samples, followed by a discussion of the nature of communities of aerial algæ, and a systematic enumeration of all the species observed, and a bibliography of literature cited. A. G.

Terrestrial Algæ.—LUCY J. HOWLAND ("The Moisture Relations of Terrestrial Algæ. IV. Periodic Observations of *Trentepohlia aurea* Martius," *Ann. Bot.*, 1929, 43, 173–202, 15 figs.). The result of two years' study of *Trentepohlia aurea*, collected and examined at fortnightly intervals over two years, to investigate the effect produced upon its growth by changes in its environment and in the seasons. The alga was studied by direct observation and experiment, and by statistical analysis of measurements of the cells. The alga can resist drought for long periods, and it survived in a desiccator for six months. After drying it quickly reabsorbs water. Plasmolysis of the cells can be effected by highly concentrated salt solutions, but less readily in desiccated cells, also less readily in spring and summer than in autumn and winter. The statistics include measurements of the lengths of 400 apical and 400 second cells, the widths of 200 apical cells, the dimensions of 400 sporangia, the number of cells in a given length (140 μ) of 200 filaments measured from apex downwards. Growth seems to be confined to the apical cell. The sizes of cells which have ceased to grow range round a mean according to a normal law, but the distribution of the lengths of growing cells is irregular. The width of the apical cell is greatest in spring and least in autumn, apart from meteorological conditions. In damp and warm weather, when growth is more rapid, shorter cells are formed. The growth of the sporangia is logarithmic, with variations corresponding with moisture conditions. A. G.

Bio-Colloids of Green Algæ.—ETIENNE LEBLONDE ("Recherches sur la morphologie et la cinétique de quelques bio-colloïdes," *Bull. Biol. France et Belgique*, 1928, 62, 415–77, 2 pls., 7 figs.). A cytological study, under the highest powers of the microscope, of the cell protoplasm of such freshwater algæ as *Conferva*, *Spirogyra*, desmids, *Edogonium*, *Cladophora*, *Vaucheria*, with chapters on the nature of colloids, the structure of bio-colloids, the mode of research followed, the facts observed, Brownian movement in the living cell, mutations of colloidal states in the cytoplasm, the kinetic properties of cytoplasmic micellæ and protoplasmic movements. The author believes that the micellæ of bio-colloids, by reason of the enormous size of each of their constituent molecules, can become big enough to be quite visible under the highest magnification of the microscope, and that granules in cytoplasm are masses of bio-colloid micellæ in more fluid suspension. These corpuscles are in movement due to molecular agitation. The micellæ are polymorphous, in single dots, or in chaplets, or curved streaks, cytoplasmic hydrosols, rendered visible by their refractivity; they are instable, and appear and disappear in the discharge of their function. The granular or sol state is the state of flux, the hyaline or gel state is the state of rest. The sol state is manifest at times of growth, division, or reproduction. In addition to the Brownian movement, which is constant for all the micellæ of living hydrosols, there is sometimes a movement of translation superposed. The formation of accessory vacuoles is discussed. A. G.

Sphæroplea.—F. E. FRITSCH ("The Genus *Sphæroplea*," *Ann. Bot.*, 1929, 43, 1–26, 8 figs.). An account of the morphology, affinities, and taxonomy of the genus *Sphæroplea* based on five species. Most of these have more or less normal septa, but the septa of *S. africana* are incomplete, being always composed of radial finger-like processes which often do not meet in the centre. In *S. annulina* and

S. Wilmani the chloroplasts constitute transverse rings, in *S. tenuis* transverse bands, but in *S. africana* a diffuse reticulum with scattered pyrenoids. Within the genus a tendency can be traced towards loss of septation, and towards the development of a diffuse reticulate chloroplast from the primitive type represented by *S. annulina* or *S. Wilmani*. This view is confirmed by the fact that, corresponding with the advance in structure, there is a greater elaboration in the oospores, these being elliptical and alate in contrast to the spherical oospores found in the simpler types. *S. tenuis* is quite exceptional; both kinds of gametes are liberated prior to fertilisation, and the oospores are formed in the outer medium. The affinity of *Sphaeroplea* is with Ulotrichaceæ rather than with Siphonales, and, indeed, *Sphaeroplea* could without difficulty be derived from a simple form like *Ulothrix*. Possibly *S. africana* and *S. tenuis* should be placed in separate genera. A. G.

Algæ of Galicia.—PIERRE ALLORGE ("Note préliminaire sur la flore des algues d'eau douce de la Galice," *Bol. R. Soc. Española Hist. Nat.*, 1928, 28, 469-76). Galicia, with its Atlantic climate and siliceous soil, has the richest flora of fresh-water algæ in Spain. A preliminary account is here given of the collections made during the summers of 1926, 1927, and 1928, and is presented in the form of four lists, the first comprising the species gathered in bogs near Santiago de Compostela, Curtis, Aranga, and Valle d'Oro; the second, the species found in siliceous lakes between Baamonde and Rabade and in Valle d'Oro; the third, the species which occur in both the above types of habitat; and fourthly, the algæ of rocks and moist talus. A. G.

Bulgarian Flagellata.—A. VALKANOV ("Beitrag zur Kenntniss der Flagellaten Bulgariens," *Bull. Soc. Bot. de Bulgarie, Sofia*, 1926, 1, 105-20, 1 pl.). A systematic enumeration of the Flagellata found by the author in Bulgaria, and collected chiefly in the neighbourhood of Sofia and Plovdiv. Fourteen new species are described and figured, one being the type of a new genus. A. G.

Macedonian Algæ.—ST. PETKOFF ("Quelques espèces de la flore algologique d'eau douce des environs de la ville de Costour (au N.O. de la Macédoine grecque actuelle)," *ibid.*, 1928, 2, 87-92). A list of 30 species of freshwater algæ from the north-east of what is now Greek Macedonia, collected by A. P. Nicoloff near Costour in April, 1927, and being the first records from this region. A. G.

Bulgarian Algæ.—ST. PETKOFF ("Note supplémentaire à la flore algologique du mont Vitocha et ses environs," *ibid.*, 93-6). A list of 12 freshwater algæ collected from submerged stones in the cold waters of a stream on the south-east side of Mont Vitocha. It supplements the list of algæ recorded by the author in his paper "La végétation des eaux de Vitocha," published in *Ann. Univ. Sofia*, 1922, 1, xviii, 1-270. A. G.

Algæ of Oasis.—A. FORTI ("Su l'aspetto della flora algologica nell' Oasi di Giarabub," *Nuov. Giorn. Bot. Ital.*, 1927, 34, 507-10). Preliminary remarks upon five samples of algæ gathered by G. Krueger in pools and wells of the Oasis of Giarabub. In such a situation are found mixtures of forms, of fresh- or of salt-water, more saprobic or less, thermal algæ. The contents of the samples are as follows:—(1) *Chara vulgaris*, var. *refracta*, with small diatoms allied to *Navicula sigmoidea*; (2) *Cladophora insignis*, with penicillate colonies of *Hydrocoleus heterotrichus*, and many small freshwater diatoms (*Navicula*); (3) *Cladophora insignis*, with numerous diatoms, including *Mastogloia Brauni* and *Campylodiscus clypeus*, both of which can thrive in sea- or freshwater; (4) a sample from the wells, containing three species

of *Phormidium* of thermophilous character, some ill-developed Chlorophyceæ, the thermophilous saline diatom *Nitzschia scalpelliformis*, the tropical *Terpsinoë musica*, and other saline diatoms; (5) *Cladophora insignis*, with *Mastogloia*, *Campylodiscus* and *Amphora* of salt-water nature. A. G.

Charophyta of Madagascar.—JAMES GROVES ("On Charophyta collected by Mr. Thomas Bates Blow, F.L.S., in Madagascar," *Journ. Linn. Soc. Bot.*, 1928, **48**, 125-37, 4 pls.). A report on a very large collection of carefully mounted charophytes made during 1924, mainly in the eastern-central part of Madagascar, 384 dried samples in all, with parts preserved in formalin. The search made was thorough, and it is a remarkable feature of the collection that it contains no diœcious species of *Nitella* or *Chara*, no heteroclemous *Nitella*, and no diplostichous diplostephanous *Chara*. There are seven species of *Chara*, mostly of wide distribution, and ten species of *Nitella*, the commonest being *N. acuminata*, only once recorded for Africa. *N. furcata* is also of wide distribution. Three others are sub-species or varieties of European species, and five new species are described. A. G.

Halidrys.—DOROTHEA G. DOUBT ("Cytology of *Halidrys dioica*," *Bot. Gaz.*, 1928, **86**, 330-44, 17 figs.). A cytological study of the south Californian brown alga *Halidrys dioica*. Among the results it is stated that there is an unbroken series of intergrades between a leaf and an air vesicle in *Halidrys dioica*. The origin of air chambers seems to be a matter of food relationships in which hyphæ play an important part. The fucosan, which Hansteen thought to be a carbohydrate or else a glucoside, seems to be a fucoxanthin plastid. Protoplasmic connections are continuous throughout the plant. The early development of the conceptacle concerns the upper rather than the basal cell. The frequent appearance of double conceptacles may be due to the action of two initials upon a single intervening wall cell. A. G.

Pelvetia.—LAURA BROOKS MOORE ("*Pelvetia fastigiata*," *Bot. Gaz.*, 1928, **86**, 419-34, 25 figs.). An account of the anatomy of *Pelvetia fastigiata*, a western American brown alga, with a description of the thallus, its apical cell, hair pits, conceptacles, and sex organs. The cell walls of the medulla and cortex were seen to be perforated by protoplasmic threads. The medullary cell walls are multi-lamellate. Cryptostomata, or hair pits, are not abundant. Conceptacles are found below the fruiting tips; the lower conceptacles have no sex organs. Often there are four eggs in each oogonium instead of the two usually found. Division is longitudinal, not transverse. Binucleate eggs occur. Abortive nuclei are extruded between the two or four eggs, not in the equator and outside, as in *P. canaliculata*. Oogonia are stalked, so also are antheridia, but only seldom are they borne on paraphyses. Antheridia have two walls. A. G.

Acrothrix on Massachusetts Coast.—WM. RANDOLPH TAYLOR ("A Species of *Acrothrix* on the Massachusetts Coast," *Amer. Journ. Bot.*, 1928, **15**, 577-83, 2 pls.). A description of *Acrothrix nova-angliæ*, a new species of a Phæophyceæ, dredged up by J. J. Copeland off Nobska Point, Wood's Hole, Massachusetts, in July, 1927. This alga develops morphogenically from an apical cell or cell row, producing an axial filament surrounded by an apparently parenchymatous cortex that ultimately enlarges to form a medullary cavity, down the wall of which the axial filament extends. The cortex is loosely covered with assimilatory filaments, the basal cells of which may also bear unilocular sporangia. This species differs from the previously described *A. gracilis* Kylin in being more extensively branched

and having sub-spherical rather than oval sporangia. *A. gracilis* is the type of the genus, and is the only other species known; it was discovered by Kylin on the west coast of Sweden. The genus is distinguished from *Dictyosiphon* by its mode of branching and its structure, and from *Chordaria* it differs in its lighter colour, greater ramification, lack of mucilage, and particularly by its structure, with a single axial strand. A. G.

Strepsithalia.—FAUSTINO MIRANDA ("Sobre una nueva especie de *Strepsithalia* Sauv. (Streps. Liebmanniæ)," *Bol. R. Soc. Española Hist. Nat.*, 1928, 28, 457–62, 5 figs.). An account of the structure of a new species of *Strepsithalia* growing epiphytically on the alga *Liebmannia Leveillei* at Antromero, near Candás. It is compared with *S. Liagoræ* Sauv., and its unilocular and plurilocular sporangia are described and figured. A. G.

Algæ on Ships.—LILIAN LYLE ("Marine Algæ of Some German Warships in Scapa Flow and of the Neighbouring Shores," *Journ. Linn. Soc.*, 1929, 48, 231–57, 9 figs.). An account of the algæ found in the late summer of 1926 on six of the German ironclads sunk in Orkney waters, where they had lain for eight years. The physical features of Scapa Flow and of the island shores are described. A systematic list of the algæ collected on the wrecks and on the island shores is given, with indication of the depths at which they occurred. Thirty-six additions are made to the local flora, some of which appear to have been imported from the Baltic, and one species—*Kylinia scapæ*—is new to science. Some brown algæ were obtained from a depth of 40 feet, and a few red algæ were found at 72 feet below the surface. A. G.

Algæ of Saint-Malo.—GONTRAN HAMEL ("La répartition des algues à Saint-Malo et dans la Rance," *Laboratoire maritime du Mus. nation. Hist. nat. à l'Arsenal de Saint-Servan. III.—Travaux du Laboratoire*, 1928, 1–27, 1 map). After giving a brief description of the geography and geology of the coasts near Saint-Malo, where the tides rise and fall over 42 feet, the author describes (1) the vegetation of the rocky coasts, first, in sheltered waters, with the various associations of algæ in the littoral, infralittoral, and supralittoral zones; secondly, on rocks exposed to the force of the waves; thirdly, in the backwash or surf; (2) the vegetation of the pools, of shaded spots or grottoes, of sandy shores, of muddy bays; and finally the vegetation of the river Rance, as far up as Dinan, where it ceases to be navigable. A. G.

Iberian Algæ.—G. HAMEL and J. FELDMAN ("La répartition géographique des fucacées et des laminaires sur les côtes occidentales de la péninsule ibérique," *C. R. Acad. Sci. Paris*, 1928, 187, 1162–3). A note on the distribution of brown algæ on the coast of Portugal. (1) Cape Ortegal marks the southern limit of *Fucus serratus*, *Laminaria flexicaulis*, *Halidrys siliquosa*, and the northern limit of *Laminaria pallida* and *Phyllaria purpurascens*. (2) The north of Portugal is the southern limit of *Ascophyllum*, *Himanthalia*, *Fucus ceranoides*, *Pelvetia*, *Laminaria saccharina*, *L. Cloustoni*. (3) Biarritz marks the northern limit of *Sargassum vulgare* and *Phyllaria reniformis*. (4) There are four species which go so far south as to reach the coast of Africa—*Fucus platycarpus*, *F. vesiculosus*, *Saccorhiza*, *Bifurcaria*. A. G.

Algæ of Spain and Portugal.—GONTRAN HAMEL ("Algas marinas de España y Portugal. I. Protoflorideas o Bangiales," *Bol. R. Soc. Española Hist. Nat.*, 1928, 28, 167–70). A first contribution to a list of the marine algæ of Spain and Portugal founded on the numerous specimens from various sources included in

Thuret's herbarium preserved in the Paris Museum of Natural History, as well as a few exsiccatae, and the author's own collections. The present contribution contains the genera *Erythrotrichia*, *Porphyropsis*, *Porphyra*, *Bangia* and *Gonio-trichum*, comprising ten species as well as four others which are likely to be found.

A. G.

Azores Algæ.—O. C. SCHMIDT ("Die marine Vegetation der Azoren," *Hedwigia*, 1929, 68, 327-46). A preliminary account of a visit made to the Azores, with remarks on the marine algæ of the islands of San Miguel, Terceira and Fayal, and indications of the algal associations studied at various situations and at various depths.

A. G.

Fungi.

Study of Phytophthora.—S. F. ASHBY ("Strains and Taxonomy of *Phytophthora palmivora* Butler (*P. Faberi* Maubl)," *Trans. Brit. Mycol. Soc.*, 1929, 14, 18-38, 9 text-figs.). The fungus *Phytophthora palmivora* is an omnivorous tropical species, and occurs as strains which differ morphologically and biologically on a wide range of cultivated plants. It causes a fruit rot and patch canker of cacao wherever that crop is cultivated, a rot and canker of *Hevea* rubber in Ceylon, and a black stripe disease of the same plant in Malaya. It also occurs on nutmeg in Java, on cotton in West Indies, on *Mimosa* sp. in the Gold Coast, on *Citrus* in the Philippines, on palms in India, Ceylon, the Philippines and West Indies, and as rots of orchids, etc., in Ceylon and Java. These various parasites have been identified as belonging to the above species, but they differ in minor respects, and have been placed in two morphological groups by Gadd, who designated them as "cacao" and "rubber" groups. The grouping corresponded not only in morphological characters, but also in biological, as oospores developed only when a member of one group was grown with a member of the other group. In these groups arose typical and atypical strains, the latter characterised by the very slow development of sporangia, but with an abundant production of chlamydospores. Ashby gives a detailed account of the behaviour and appearance of these strains on culture media and also when transferred to water. Sexual organs were detected by Ashby in 1922 in mixed cultures of the West Indian cacao strain with the Jamaica coconut strain. The occurrence of oospores and oogonia on the paired mycelia is described. Sexual spores have not been recorded in single-strain cultures, but oospores are formed within a few days when a member of one group is grown with a member of the other. Many measurements were made of sporangia, etc., in the different strains. Attention is given to the nomenclature of this widespread species, which has naturally received a number of names according to each new host on which it was found. Butler first described it as *Pythium palmivorum*, on the Palmyra palm and also on coconut in Madras, but he transferred it to *Phytophthora* in 1919, and as his is the earliest name, it is the one adopted. A full list of literature is given.

A. L. S.

Study of Achlya.—MARGERY C. CARLSON ("Gametogenesis and Fertilization in *Achlya racemosa*," *Ann. Bot.*, 1929, 43, 112-17, 1 pl.). The material from which the study was made was collected from the tanks of a fish hatchery at Hayward, Wisconsin. It occurred on *débris*, but not on the fish. Cultures were made, the methods employed being described, and the life development was followed. This species of *Achlya* is monœcious, oogonia and antheridia being borne on the same branch. Their development presented no new features. There was one mitotic division of the nucleus both in the oogonium and in the antheridium; there was

no indication that the division was heterotypic. A fertilisation tube from the antheridium enters the oogonium and discharges one nucleus, which fuses with the oogonial nucleus. The plate is a double one, and the different stages of development of the reproductive organs and of the nuclei are clearly represented. A. L. S.

Downy Mildews of the Nettle.—E. S. SALMON and W. M. WARE ("Two Downy Mildews of the Nettle *Pseudoperonospora Urticæ* (Lib.) Salm. et Ware and *Peronospora de Baryi* nomen novum," *Trans. Brit. Mycol. Soc.*, 1929, 14, 38–60, 6 text-figs.). The authors begin by a discussion on the distinction between two species of mildew, both of which they have found on nettles. *Peronospora de Baryi* forms a silvery yellow growth at the tips of the main stems; *Pseudoperonospora Urticæ* occurs as dark greyish lilac masses of conidiophores and conidia. The first described was given the name *Botrytis Urticæ* Berk. and Broome, later transferred by Caspary to *Peronospora*. As the sporangia give rise to zoospores, its correct designation is *Pseudoperonospora*. The second species, a true *Peronospora*, was published by De Bary as *Peronospora Urticæ*, but is now found to differ from the earlier found fungus. The authors of the paper have thoroughly studied both species in nature and in the laboratory. Inoculations were made and the condition of the host leaves and stems is described as a result of penetration by the fungus. Both fungi are widely distributed. A. L. S.

An Aquatic Ascomycete.—WILLIAM H. WESTON ("Observations on *Loramycetes*, an Undescribed Aquatic Ascomycete," *Mycologia*, 1929, 21, 55–76, 2 pls.). The writer discovered this plant while studying the various orders of submersed Phycomycetes. It was always found only on dead softened culms of *Juncus militaris* submerged from a depth of a few inches to as much as three feet in fresh pond-water. It is a Pyrenomycete. The fruiting bodies, when mature, are almost spherical, up to 2 mm. in diameter, flattened-spherical and dark in colour, opening by an ostiole. The outer wall is somewhat gelatinous; the ascospores are colourless and 2-celled, with a caudal appendage. Weston finds in this type of fungus a wonderful adaptation to a submerged existence: the spores emerge singly and sink down head first, and are washed about until they encounter a suitable *Juncus* stem, on which they germinate, forming a mycelium from which arise new perithecia. The fungus has been placed in a new species and genus, *Loramycetes juncicola*. A. L. S.

Spermagonial Development.—CHESTER A. ARNOLD ("The Development of the Perithecium and Spermagonium of *Sporormia leporina* Niessl," *Amer. Journ. Bot.*, 1928, 15, 241–5, 2 pls.). Artificial cultures were made, fruiting structures of spermagonia developing in about a fortnight; perithecia appeared a few days later. The perithecia originate as single swollen cells containing one nucleus; cell division takes place, and the formation of cavity and walls was followed. Vertical hyphæ arose at the lower end of the cavity, and from enlarged cells at their tips the ascogenous hyphæ appeared to develop. Pairs of minute nuclei could be observed in the penultimate cell of the ascus hooks. The spermagonia arise from rhizomorphs intermingled with the vegetative mycelium; spermatia develop in a gelatinous mass in the interior and finally escape as in the closely-related *Sordaria coprophila*. A. L. S.

New Fern Rust.—J. C. ARTHUR ("Another Fern Rust of the Genus *Desmella*," *Mycologia*, 1929, 21, 77–8, 1 text-fig.). Arthur considers that fern rusts are peculiarly interesting owing to the "ancestry of the hosts and a seemingly corresponding ancestry of the accompanying rusts." The genus *Desmella* is a

primitive type with few species. A new species, *D. obovata*, has been added, of which only the Uredinia have been found. It was collected in Jamaica by W. R. Maxon in a wet forest. A description of the new species is given. A. L. S.

Study of Rust Uredinia.—E. H. MOSS ("The Uredinia of *Melampsora* and *Coleosporium*," *Mycologia*, 1929, 21, 79–83, 2 text-figs.). The writer has made a special study of the peridium of these two genera in order to determine its occurrence and the course of development. He found that a peridium was present in various species of *Melampsora*. He regards it as homologous with the peridia of Pucciniastreae. He found no peridium in *Coleosporium Solidaginis*. A. L. S.

Culture Studies of Rusts.—W. P. FRASER and G. A. LEDINGHAM ("Studies of the Sedge Rust *Puccinia Caricis-Shepherdiae*" *Mycologia*, 1929, 21, 86–9, 1 pl.). Cross-inoculations have been made with the teleutospores of the sedge and the æcidiospores from *Eleagnus commutata*, *E. angustifolia*, *Lepargyrea argentea* and *L. canadensis*. The inoculations were in all cases successful, and proved the relationship between the rusts. In one case pycnidia but no æidia were produced, which may indicate biologic forms within the species. A. L. S.

Ustilago echinata Schroet.—D. M. BENEDICT (*Mycologia*, 1929, 21, 84–5, 1 text-fig.). Benedict found the grass *Phalaris arundinacea* heavily infected with the smut *Ustilago echinata*. As a result, the culms of the host plants failed to develop the inflorescence, which is forced back on itself and appears swollen, twisted and contorted. The blade and leaf sheath are frequently wrinkled. The smut sori appear on the hypertrophied inflorescence as well as on the blade and sheath. A. L. S.

Experimental Study of Fusarium.—CHIH TU ("Physiologic Specialization in *Fusarium* spp. causing Headblight of Small Grains," *Phytopathologist*, 1929, 19, 143–54). *Fusarium* headblight (scab) of cereals, along with seedling blight also caused by a *Fusarium*, are serious diseases in many countries. The research was undertaken to ascertain the conditions in which the fungus attack was most virulent and thus to be able to control the disease. The idea was that there might be special physiological forms of more intense pathogenicity than others, and there was need to understand their conditions of successful growth. Isolations were made and several cultures were started of *Fusarium graminearum*, *F. culmorum* and *F. avenaceum*. All these species induced headblight, but varied in their infective power; the percentages of successful inoculation are duly set forth. A time of very hot weather had, however, a deterrent effect. It was found that temperature had considerable influence on the growth of the fungus; the optimum temperature was ascertained for each fungus culture. Mutation occurred in one of the forms of *Fusarium culmorum*. A. L. S.

Polyporaceæ of Bulgaria.—B. BARSAKOFF (*Bull. Soc. Bot. Bulg.*, 1926, 1, 21–36, Bulgarian with German summary). The author has determined 46 species of this genus belonging to 7 genera. Notes are given on the different fungi, with localities, etc. A. L. S.

Air Fungal Flora.—W. A. R. DILLON WESTON ("Observations on the Bacterial and Fungal Flora of the Upper Air," *Trans. Brit. Mycol. Soc.*, 1929, 14, 111–7). Tests were made by the Cambridge University Air Squadron by exposing prepared plates at different altitudes and at different seasons of the year. It is stated that 40 p.c. of the exposures were positive, showing the ubiquitous nature of microscopic plant life. Plates exposed at 9,000 and 10,000 ft. showed only bacterial colonies. There were more spores present in the clouds than above or

below them, and the spores are much more numerous in summer than in winter. Spores were found to be viable at two miles above the earth. Air dispersion may thus account for epidemics of plant disease.

A. L. S.

Fungi: an Introduction to Mycology.—J. RAMSBOTTOM (*Benn's Sixpenny Library*, London, Ernest Benn, Ltd., Bouverie House, Fleet Street, 1929, 1-80, 2 pls.). In this comprehensive outline of mycology the author gives us, in the introductory chapter, a sketch of the views held as to the origin and evolution of the vast group of Fungi, along with their place and function in the vegetable kingdom, and their relation to other plants, living as they do either as saprophytes, parasites or symbionts, very hurtful when they prey on living plants, but extremely useful as scavengers, etc. A second chapter is devoted to structure, the many forms of the fungal plants, with the manner of their growth and occurrence. A third chapter takes up the subject of "Fungi and Man," their direct use to humanity as food, the utilisation of their enzymes in fermentation processes, and finally the diseases of the human frame traced to fungi, such as "thrush," "Madura foot," etc. The chapter on Plant Pathology gives an inkling of the great economic importance of fungi down to the minutest forms, which are capable of destroying a nation's economic crops in a short time, as witness potato disease and the rusts and smuts of cereals. The author then passes to a consideration of fungi as symbionts—that is, living in mutual helpfulness with other plants. Fungi require to be provided with ready-made carbohydrates, but they are able to pay back with other substances. This state of mutualism or symbiosis is achieved in *Mycorrhiza*, which is described—not only the association with the roots of the higher plants, but the methods of association and an account of the fungi which lend themselves to the formation of "fungus root." Another outstanding example of symbiosis is the lichens, and the result of the combined life is described as it occurs in these plants. "Fungi and Insects," their relation and interrelation, also receive attention, and finally "Ecology and Classification" are discussed. A short "Bibliography" is appended to acquaint the student with some of the leading works on the subjects dealt with.

A. L. S.

Economic Mycology.—E. J. BUTLER ("The Development of Economic Mycology in the Empire Overseas," *Trans. Brit. Mycol. Soc.*, 1929, 14, 1-18). This subject was treated by Butler in a presidential address to the members of the Mycological Society. He confined himself deliberately to the activities of mycologists who worked in the Dominions and colonies. Their work, however, was made possible through the previous study of exotic mycology by men like Berkeley and Cooke. In 1869 the coffee plantations of Ceylon were devastated by disease, but not until 1880 was the trained mycologist H. Marshall Ward sent to investigate and report. He carried out the first detailed study of a tropical disease. Marshall Ward was followed by others—though at considerable intervals—who worked on the economic study of fungal parasites. Diseases of such crops as tea, rubber, cacao, cereals, etc., have caused immense losses in the various overseas countries, and Butler has given an account of these, and of the mycologists who devoted themselves to economic study. In most of the countries there are now official plant pathologists who are fitted to deal with any outbreak of plant disease. About a hundred of these trained officers are now working in Government service. In many of the colonies agriculture of some form is the main industry, and large areas are unfortunately planted continuously with the same plants, thus leading to the rapid and disastrous spread of any disease that may attack the crop. More study and more students are required to cope with economic disease, its cause and cure.

A. L. S.

Physiology of Fungi.—CHARLES PONTILLON ("Physiologie végétale. Sur l'existence de résines chez le *Sterigmatocystis nigra* V.Tgh.," *Compt. rend. Acad. Sci. Paris*, 1929, 188, 413-15). The author, in the course of his study of "lipides," was led to suspect the presence of resins in *Sterigmatocystis*. Their presence in some of the lower fungi had previously been proved—a phenolic acid in *Aspergillus Oryzæ*, by Yabata, as well as in other species of that genus; two similar acids have been isolated from two *Penicilliums*. Zopf also indicated that the red colouring matter secreted by old mycelia of *Aspergillus glaucus* was probably a resin. Pontillon describes the methods adopted for this "histochemical" research. The problem was attacked in several different ways, which are given in detail. Finally it was concluded that resins were certainly present in *Sterigmatocystis*. It now remains to be proved whether these resins affect the quantitative analysis of the "lipides."

A. L. S.

Influence of Temperature on Mutation.—J. J. CHRISTENSEN ("The Influence of Temperature on the Frequency of Mutation in *Helminthosporium sativum*," *Phytopathology*, 1929, 19, 156-62, 4 text-figs.). Various general notes were made on mutation in *Helminthosporium sativum*. It was proved that it might mutate more frequently on one nutrient medium than on another, and that some forms mutated more readily than others, and also that the amount of medium affected mutation, it being most frequent when small amounts of medium were used. Details are given of the various cultures. From these it was proved that temperature had a profound influence on its frequency, and also that high temperatures were the most effective. The mutants thus obtained possessed stability, some of them having retained their acquired characteristics for four years, though some reversions have occurred. To test their stability still further, several mutants were inoculated on wheat, and after full growth on the host were again transferred to culture plates. It was found that the mutant characters persisted, the living host having had no influence on this form of the parasite.

A. L. S.

Studies on Morphogeneses in Fungous Mycelia.—ILLO HEIN (*Bull. Torrey Bot. Club*, 1928, 55, 515-28, 1 pl.). The author has made a study of the direction of growth of fungous mycelia at early stages. He finds that such growth is invariably radial, growing outwards from the germinating spores in all directions. The main hyphal branches grow radially and branch profusely; the branches also all tend to grow radially away from the centre. The aerial mycelium also grows radially. Tests were made by placing barriers such as grains of sand in the culture; the hypha, on encountering the barrier, changed direction to get round and then continued the radial growth. The writer discusses the influences that may have a bearing on radial orientation, and compares the growth of the hyphæ with the radial growth of roots. This was considered to be influenced by the plant form as a whole, called by Noll (1894) *Morphæsthesia*. Hein thinks a similar stimulus may determine the radial growth in mycelial hyphæ. A copious list of papers is supplied.

A. L. S.

Biology of Fungus Infection.—M. C. RAYNER ("The Biology of Fungus Infection in the Genus *Vaccinium*," *Ann. Bot.*, 1929, 43, 55-72, 2 pls.). The author has correlated this study with her work on *Calluna*. She claims that the presence of the fungus and its position in regard to the host plant lend support to the relationship of *Vaccinium* with members of the Ericaceæ. *Vaccinium Orycoccus* and *V. macrocarpum* were the species chiefly examined. It was found that the fungus penetrated through the shoots to the ovaries and organs of the flower, and that the seeds were therefore subject to infection while still in the fruit chambers; also that infestation of the seed was even more extensive than in *Calluna*. It was

not possible to obtain seeds free from infection, and the author concludes that normal seed development is bound up with such infection, and that there is an obligate relationship between the two organisms. It was also demonstrated that there is a distinct and separate mycorrhizal invasion as well which takes place in the soil, in this characteristic also resembling *Calluna*. A. L. S.

Serological Investigation of Fungi.—TAKASHI MATSUMOTO ("The Investigation of *Aspergilli* by Serological Methods," *Trans. Brit. Mycol. Soc.*, 1929, 14, 69–88). Serological methods have been used to distinguish bacterial strains. Thus an immune strain secured from a rabbit inoculated with the emulsion of yeast spores gave agglutination reactions, while the normal serum agglutinated only slightly. The author applied this method with spores of 23 species or strains of *Aspergillus*. He describes his methods of procedure, the number of spores used for inoculating the rabbits, and the examination of the serum. Agglutination tests were not found to be successful, and he concludes that they cannot be adopted as a basis for the classification of *Aspergillus*. A. L. S.

Study of Fungus Fermentation.—HIROSHI TAMIYA and YASUSABURO MIWA ("Ueber die anærobie Atmung von *Aspergillus*arten," *Zeitschrift für Botanik*, 1929, 21, 417–32, 7 text-figs.). The writers have proved by a series of researches that *Aspergillus* species usually considered as of weak fermentative power really show fermentation in various degrees. Among the most active was *Aspergillus clavatus*, almost as active as the yeasts. Others, however, among them *Aspergillus glaucus*, were deficient. They found also that young mycelia were more rich in fermentative action and in the formation of zymase. Species cultured in a peptone solution mostly fermented a sugar culture. By glycerine extraction it was possible to prove the presence of zymases, and a certain quantity of zymase was always found in most of the species examined. The quantity of the ferment and the power of mycelial fermentation were equal. Exception to that rule was found in *Asp. clavatus*, and has not yet been cleared up. A. L. S.

Fungi costaricensis.—H. SYDOW and F. PETRAK (*Ann. Mycol.*, 1929, 27, 1–86). The fungi here dealt with were collected mainly by Prof. Alberto M. Brenes during a residence in Costa Rica. Sydow also took part in some of the excursions, and the result has been a very large collection of Micromycetes with an unusual number of new species. Naturally many of them are parasites on various plants. Full descriptions are given of microscopic details. The new genera are *Brenesiella*, *Biotyle*, *Bioportha*, *Hypocelis*, *Micromyriangium*, *Platypeltella*, *Polythyrium*, *Ciliophora*, *Achropeltis*, and *Aorate*, the last-mentioned a Hyphomycete. A. L. S.

Critical Work on Microfungi.—F. PETRAK and H. SYDOW ("Kritisch-systematische Originaluntersuchungen über Pyrenomyzeten, Sphærospideen und Melanconieen," *tom. cit.*, 87–122). The authors have revised a large number of genera and species, criticising and redescribing old species and new. Thus *Discella microsperma* B. and Br. becomes in their view *Myzofusicoccum aurora* V. Höhn. Many similar changes are made. A. L. S.

Fungus Flora of Juan Fernandez.—K. KEISSLER ("Nachtrag zur Pilzflora von Juan Fernandez," *Nat. Hist. Juan Fernandez and Easter Island*, 1928, 2, 549–50, 1 text-fig.). Keissler adds to his previous record of fungi of these islands by giving an account of *Corticium subsphaerosperum* Litsch. n. sp. characterised by somewhat angular spores. He also records species of *Nectria*, etc., not previously noted. A. L. S.

Oregon Fungi.—S. M. ZELLER ("Contribution to Our Knowledge of Oregon Fungi—III," *Mycologia*, 1929, 21, 97–111, 3 text-figs.). This paper is a continuation of lists previously published by Zeller. In the present lists 83 species belong to the Basidiomycetes. One of these, *Clavaria occidentalis*, is a new species. *Amanita pantherina* is a new record for North America, and was the cause of a severe, though not fatal, case of poisoning. The remaining species are Fungi Imperfecti, one of which, *Phymatotrichum fungicola*, is new to science. A. L. S.

Seed Mixtures and the Incidence of Fungal Disease.—E. WYLIE FENTON (*Trans. Brit. Mycol. Soc.*, 1929, 14, 88–93). The writer gives an account of plots sown with different mixtures of seeds. In some plots rusts appeared on the grasses, while others were healthy. Fenton gives the reasons for the health or unhealth of the plots; he emphasises the value of wild white clover. Some of the plots had been used as poultry runs, and the heavy addition of nitrogen to the soil favoured the growth of the rust *Uromyces Dactylidis*. He concludes that a pathological condition generally originates with unfavourable physiological conditions, which, however, can be counteracted by a well-balanced seed mixture. A. L. S.

Spread of Apple Mildew.—F. R. PETHERBRIDGE and W. A. R. DILLON WESTON ("Observations on the Spread of the Apple Mildew Fungus, *Podosphaera leucotricha* (Ell. and Ed.) Salm.," *Trans. Brit. Mycol. Soc.*, 1929, 14, 109–111). The authors have questioned the statement that the outbreak of mildew disease in spring is due to hibernating mycelia in the buds. By inoculating experiments the authors proved the spread of the disease to be due to fungus spores causing a secondary infection in spring. A. L. S.

Bulgarian Parasitic Fungi.—T. DIMITROFF ("Les champignons nuisibles aux forêts bulgares," Bulgarian with French summary, *Bull. Soc. Bot. Bulg.*, 1926, 1, 53–66). The author has confined his study to the diseases of forest trees. He records 38 fungal attacks by many different fungi. The trees that suffer most are pine, fir, oak, etc. A. L. S.

Willow Scab Fungus.—G. P. CLINTON and FLORENCE A. McCORMICK (*Conn. Agric. Exp. Station, Bull.* 302, 1929, 443–69, 8 pls.). The fungus causing the disease on willows in America has been identified as *Fusicladium saliciperduum*, long known in Europe, but only known in America in recent years, though it is stated to have been found in Greenland and Ellesmere Island by Rostrup in 1888. It does enormous damage to the trees attacked, mostly shade trees, belonging to nine different species, some being more susceptible than others. The perfect stage of the fungus, *Venturia*, has not yet been found; it is probable that the disease is carried over in the *Fusicladium* conidial stage by overwintered cankers. The authors describe the attack and development of the fungus, and give an account of infection experiments both on leaves in the laboratory and on growing trees; they also describe spraying experiments, which were unusually successful. They add a history of the disease in Europe and a bibliography of 78 papers. A. L. S.

Plant Diseases.—F. T. BROOKS (*Oxford Univ. Press*, 1928, 1–386, 1 pl., 62 text-figs.). "By diseases in plants is meant some disturbance in the normal life-processes." Following up this statement in the introduction, the author discusses the causes, symptoms, dissemination and control of plant diseases. Non-parasite diseases, such as chlorosis, are treated first, then follow the series of definitely parasitic infections, mostly due to bacteria and fungi. The disease in each case is described, with the causal organism, and the method of attack; instructions are added as to the best methods of treating disease and preventing further extension.

Diseases of dead plants, such as dry-rot of timber, are also considered. Notes are given as to disease caused by green algæ on leaves of tea in India—*Cephaleuros parasiticus*—it forms red or purple spots on the leaves, known as red rust. The final chapter supplies an account of fungicides and the methods of application. Full references to literature are given at the close of each section. A. L. S.

Mosaic Disease of Tobacco.—C. G. VINSON and A. W. PETRE (*Bot. Gaz.*, 1929, 87, 14–38). The authors have made a prolonged study of the properties of the virus of mosaic disease. They find that “the behaviour of virus is in many ways analogous to that of a chemical substance.” After securing juice from infected plants, they precipitated the virus by means of an aqueous solution of safranin. After being re-dissolved in water, the solution was subjected to a series of tests—heat tests which affect its power of infection, and the action of alcohol and various chemical substances such as lead acetate and barium acetate. A summary of results is given and a list of the literature cited. A. L. S.

Local Lesions in Tobacco Mosaic.—FRANCIS O. HOLMES (*Bot. Gaz.*, 1929, 39–63, 11 text-figs.). Experiments in inoculation of *Nicotiana* spp. were made by the writer, and the local lesions are described. Generally, dark spots were formed on the leaves near the point of infection; in size and form they varied in the different host species. The strength of the infection could be calculated from the number of lesions formed. A. L. S.

Inoculating Methods in Tobacco Mosaic Studies.—FRANCIS O. HOLMES (*tom. cit.*, 56–63, 4 text-figs.). The usual method of experimental inoculation has been to scratch or prick the leaves and wet the wounded area with extracts from mosaic plants. Various tests were carried out as to the type of wound that gave readiest entrance to the virus. Finally it was proved that the most effective way of inoculation was to rub over a leaf surface gently with a cloth soaked in mosaic extract. The virus does not readily enter wounds, and scratches were therefore less effective. The entrance of the virus seems to be instantaneous as immediate subsequent washing did not lessen the attack. A. L. S.

Dominican Fungi.—ROMUALDO GONZALEZ FRAGOSO and RAFAEL CIFERRI (“Hongos parasitos y saprofitos de la republica dominicana,” *Estacion Agronomica de Moca, ser. B., Botanica*, 1928, no. 11, 1–79, 36 text-figs.). The authors have here collected and issued the descriptions and records of fungi published at various intervals. The number of species amounts to 150, in addition to 306 species already published. Many of these fungi are parasitic on living plants, and a list of the host plants with the parasites is given. There is also an index of the genera dealt with in the pamphlet. Ascomycetes and Fungi Imperfecti are the most numerous; there are few Uredineæ. A. L. S.

Study of Botrytis cinerea.—W. R. C. PAUL (“A Comparative Morphological and Physiological Study of a Number of Strains of *Botrytis cinerea* Pers., with Special Reference to Their Virulence,” *Trans. Brit. Mycol. Soc.*, 1929, 14, 118–35, 1 pl., 2 text-figs.). The writer selected six strains, from diseased geranium leaves, chrysanthemum leaves, hyacinth bulbs, etc. Finally he carried out his research with three of these strains—I, a sclerotial type, II, a mycelial type, and III, a sporing type. Many aspects of growth were studied—the effect of humidity, the production of enzymes, the different intensities of parasitism and the penetrating power of the fungal hyphae. The results as regards the growth features of these several strains are fully described. A. L. S.

Rhizoctonia bataticola and Tea Root Diseases.—C. H. GADD (*Trans. Brit. Mycol. Soc.*, 1929, 14, 99–109). This paper is a reasoned answer to W. Small's contention that the above fungus is the primary cause of practically all root diseases in the tropics. The many other fungi that have been causing root trouble were considered by him to be secondary growths. Gadd has taken up Small's statements, more especially as regards tea root diseases, and, in contradistinction to Small, he states that "I see no reason for supposing that *R. bataticola* ever causes a pathological condition of tea."

A. L. S.

Note on Rhizoctonia croccorum (Pers.) D.C.—W. M. WARE (*Trans. Brit. Mycol. Soc.*, 1929, 14, 94–5). This fungus is the cause of violet felt rot of various crops, such as sugar beet, mangolds, lucerne, potato, etc. It was found attacking red clover in 1922. The following year *Helicobasidium purpureum* occurred on the same crop, thus strengthening the view that it was the fruiting form of the *Rhizoctonia*. Notes are given on the various grass crops that were sown on the field. In 1926 a mixture of trefoil (*Medicago lupulina*) and white clover was sown. Both plants were attacked by *Rhizoctonia*, and in the following spring *Helicobasidium* appeared. Ware does not consider that biologic forms of the fungus need be considered; he was evidently dealing with just the same parasite.

A. L. S.

Field Notes on an Attack by Rhizoctonia croccorum on Sitka Spruce (Picea sitchensis).—H. WATSON (*tom. cit.*, 95–6). The disease occurred in a forest nursery at Beauly, Inverness-shire, and was indicated by a yellowing of the plants attacked. Examination showed the "collar" to be surrounded by the violet mycelium, with the black dots typical of the parasitic fungus *Rhizoctonia croccorum*. The spruces were two-year seedlings which had been lined out for a further two years, and were sixteen to twenty-four inches in height. The fungus was also found on a number of weed plants in the nursery, and as these are difficult to eradicate, the economic outlook is rather serious.

A. L. S.

Further Notes on the Connection between Rhizoctonia croccorum and Helicobasidium purpureum.—W. BUDDIN and E. M. WAKEFIELD (*tom. cit.*, 97–8). The writers give notes on cultures of *Rhizoctonia* from various sources, and their experience confirms their views that strains of *Rhizoctonia* from different host plants vary in virulence. They have also confirmatory evidence of the connection between *Helicobasidium purpureum* and *Rhizoctonia croccorum*. They obtained material of the attacked Sitka spruce from Beauly. With nine of the ten plants received, the collar was encircled by the violet fructification of *H. purpureum*, and the connection between this growth and the *Rhizoctonia* on the roots was unmistakable.

A. L. S.

List of the Common Names of British Plant Diseases.—(Compiled by the Plant Pathology Sub-Committee of the British Mycological Society, *Trans. Brit. Mycol. Soc.*, 1929, 14, 140–77). The list has been drawn up in order to secure conformity in the popular nomenclature of diseases that affect plants in the British Isles, and thus avoid confusion and misunderstanding. The list is based primarily on the "Report on the Occurrence of Fungus, Bacterial and Allied Diseases of Crops in England and Wales." The list has been arranged in two parallel columns, in one with the name of the host and the common name recommended, while in the other list there is the scientific name of the parasite. Many of the diseases are prevalent in foreign countries as well as in the British Isles, and are there known under various names. Where advisable these names are added, with a numbered reference to the country of origin. The sub-committee have recognised that this first attempt at a

list must be considered as tentative and provisional, and they invite suggestions and criticisms from workers in the same field. The host plants are in alphabetical order under the different sections such as cereals, pasture crops, root crops, etc.

A. L. S.

Lichens.

Lichens in the Regnell Herbarium.—GUST. O. A. N. MALME ("Lichenes pyrenocarpi aliquot in herbario regnelliano asservati," *Ark. för Bot.*, 1929, **22**, no. 6, 1–11). Malme has published papers on pyrenocarpous Regnell lichens—on Astrotheliaceæ, Paratheliaceæ, and Trypetheliaceæ. The present paper deals with genera of which only a few species have been brought home. He opens with a discussion on some of these genera, and gives reasons for considering them redundant. The species described are nearly all new to science. He gives one new genus, *Porinopsis*, though he is doubtful as to its status. It differs from the well-known *Porina* in the number of spores—usually only two in the ascus. He suggests that it may be only worthy of "section" status. Only one species of the new genus is given, and that was found at several localities.

A. L. S.

Nova Zembla Lichens.—A. ZAHLBRUCKNER ("Die Gattung Lecanora," *Report of the Scientific Results of the Norwegian Expedition to Novaya Zemlaya*, 1921, no. 44, Oslo, 1928, 1–32, 4 pls.). The lichenologist of the expedition, Dr. Bernt Lynge, collected a large series of lichens, which he himself has described and published, with the exception of the two genera *Acarospora* and *Lecanora*. Zahlbruckner, to whom the Lecanoras were entrusted, has now published his results. He has listed and described 52 species and many varieties, a considerable number of which are new to science. Many valuable biological notes are given.

A. L. S.

Canadian Lichens.—LUCY C. RAUP ("A List of the Lichens of the Athabasca Lake Region of North-Western Canada," *Bryologist*, 1928, **31**, 83–5). A collection of about 1200 specimens, representing 77 species of lichens, was made by the writer in this far northern Canadian region of the Mackenzie drainage basin. The list includes members of widely diverse families. One species of Graphidaceæ was found—*Opegrapha varia*—on a drift-log. Most of the species are distinctly of northern distribution.

A. L. S.

Java Lichens.—A. ZAHLBRUCKNER ("Neue und ungenügend beschriebene javanische Flechten," *Ann. Crypt. Exotique*, 1928, **1**, 109–212). The author gives an account of the various collections of lichens from Java that have been sent to him or submitted to him for examination. The most important are those of W. van Leeuwen, the Director of the Botanic Gardens, Buitenzorg, and of C. van Overeen. Specially commended is the collection of Prof. V. Schiffner, owing to the quality of the specimens and their careful preparation. Most of the species described are new to science, but occasion has been taken to examine and redescribe species already named, but imperfectly diagnosed. Zahlbruckner instances *Parmelia* species as requiring a careful account of chemical reaction and of the pycnoconidia, though he himself describes a new species, *Parmelia pecticratula*, in which neither apothecia nor pycnidia were seen. One new genus and species, *Bogoriella subperficina*, is described. The genus is allied to *Microthelia*. Pycnidia were absent.

A. L. S.

Distribution of Lichens.—O. V. DARBISHIRE ("Roccellaceæ Mass. (Nyl.)," *Die Pflanzenareale. Zweite Reihe*, Heft. 1, 1928, 1–4, 5 pls.). The author, in his survey of distribution of lichens, considers the task almost impossible for crustaceous species. Herbaria would need to be critically examined, and in these the old

material is frequently of little value. Darbishire has, however, drawn out a scheme of distribution for the somewhat restricted family of the Roccellaceæ, comprising 13 genera and 33 species. They mostly belong to warmer maritime regions. The author has traced the occurrence of members of the family according to isotherms.

A. L. S.

Cetraria norvegica in Sweden.—GUNNAR NILSSON ("Cetraria norvegica (Lynge) D.R. in Fennoskandia," *Svensk Bot. Tidskr.*, 1928, 22, 515–27). The lichen in question has been known in Europe as *Cetraria lacunosa*. Du Rietz has discovered that *C. lacunosa* is without isidia, and is of American distribution. The European form is now to be known as *C. norvegica*. It grows on rocks. The American plant grows on trees. It forms one of a group of somewhat lowland sub-Atlantic plants that are also found intruding into northern latitudes. Nilsson gives ecology and distribution.

A. L. S.

Study of Siphula.—S. GARSIDE ("The Structure and Mode of Reproduction of *Siphula tabularis*," *Trans. Brit. Mycol. Soc.*, 1929, 14, 60–9, 1 pl., 4 text-figs.). The genus *Siphula* was established by Nylander in 1859, he thought it might be a deformed condition of some more perfect plant. It is a true lichen genus, but never forms a fruiting stage. The thallus of the Cape species, *S. tabularis*, occurs as large whitish or greyish patches on the surface of sandstone rocks in the streams of Table Mountain, at fairly high altitudes; it is attached to the rocks by stoutish rhizinae. When the thallus has attained a moderate size, the tips of the thallus lobes change their direction, and become more or less vertical and form short podetia which have a radial structure. At a further stage the tip of the podetium becomes flattened and verrucose with small isidioid growths, which differ from normal isidia in that they originate in the gonidial zone, where already they acquire a cellular cortex. In time they emerge in the open and become scattered, giving rise to new plants and colonies of plants. Garside proposes for them the term endoisidia to distinguish them from other somewhat similar structures which arise exogenously from the outer cortex. The growth of the podetium ceases on the production of these isidia, unless one of them remains attached and starts the formation of new podetia. It is very rare to find more than one "germinating" on a podetium. If an isidium falls on the parent thallus, it may become attached and start a new growth, and thus arises a confusion of tangled growth. There is no other method of reproduction known, and so far no similar isidia have been noted in other species. *Siphula tabularis* grows best in full sunlight; in very shady places no podetia are formed. There are about fourteen species of this genus, widely distributed. One is fairly common as far north as Scandinavia; none has been found in the British Isles. Three species occur in S. Africa. Thunberg first collected *Siphula tabularis* between 1772 and 1779. Linnæus described it in 1781 as *Lichen verrucosus*. Acharius published and figured it in 1803 as *Stereocaulon tabulare*.

A. L. S.

Properties of Cetraria islandica.—SELINI AUGUSTE ("Recherche sperimentali sul Lichene islandico e sulle sue possibili applicazioni in tintoria," *Bol. Soc. dei Naturalisti, Napoli*, 1928, 39, 207–10). Auguste has divided his account of "Iceland Moss" into two parts: (1) descriptive, giving the general appearance, nature, and use of the lichen, and (2) experimental, in which he records his researches on the dyeing properties, either in simple solution or in conjunction with mordants, salts, etc. Chiefly he has so far concentrated on the colouration of kid gloves, either glacés or suèdes. He has found that the lichen is peculiarly favourable for securing clear pastel tones. Other memoirs are to follow.

A. L. S.

Study of Gyrophoraceæ.—ROGER-GUY WERNER ("Etude de la famille des Gyrophoracées," *Compt. rend. Acad. Sci. Paris*, 1928, **186**, 1367-8). Werner gives some biological notes as to the occurrence of members of this family. The Gyrophoraceæ inhabit alpine regions; *Umbilicaria pustulata* descends to lower altitudes; they all inhabit siliceous rocks. An account is given of the morphological structure of *U. pustulata* and of the fructification. The ascogonium begins as a small cushion of closely-packed cells with dense contents. From each cushion arises a "true" trichogyne. These ascogonia are numerous at the end of autumn and during the winter. They become transformed to ascogonial hyphæ and young asci. Perithecia are also developed, of which the sterigmata and spores are of the *Sticta* type. Werner did not succeed in inducing germination of the ascospores. Reproduction is secured by isidia. *Gyrophora cylindrica* and *G. erosa* were also studied. Development resembled that of *Umbilicaria*, but the ascogonia gave rise to several trichogynes.

A. L. S.

Lichen on Bone Substratum.—E. BACHMANN ("Die Beziehungen der Knochenflechten zu ihrer Unterlage," *Ber. Deutsch. Bot. Ges.*, 1928, **46**, 291-7, 1 text-fig.). The lichen in question, a species of *Verrucaria*, formed a dark thallus on the surface of the bone. It had been classified among endolithic lichens, but a careful examination has caused Bachmann to remove it from *Verrucaria submuralis*, an endolithic species, to the section represented by *V. athiobola*. His view has been strengthened that lichen hyphæ are not able to dissolve bone material, and so cannot be considered as endolithic.

A. L. S.

Teratology in Lichens.—M. CHOISY ("Sur un cas tératologique curieux du *Parmelia proliza* Ach.," *Arch. de Bot.*, 1928, **2**, 82-4, 2 text-figs.). Choisy found an apothecium of *Parmelia* growing and deprived of lichen thallus. It was about 1 cm. in width and was attached to the substratum at one point. The disc was invaded by numerous brown perithecia, which he diagnosed as those of parasitic fungus *Discothecium araneosum*. He considers that the attack of the parasite rendered further growth by the lichen thallus impossible, the parasite using up the material contributed by the alga.

A. L. S.

Epiphyllous Lichen in Europe.—M. CENGIA SAMBO ("Un lichene epifillo su una Palma di Serra dell' Orto botanico di Firenze," *Nuovo Giorn. Bot. Ital.*, 1928, **35**, 257-8). Epiphyllous lichens are, with few exceptions, tropical plants. In a hot-house at Florence Botanical Gardens Cengia Sambo found the leaves of a plant covered with a lichen thallus. It was sterile, but was considered to be *Lecanora micrommata* Krempel., which grows normally on palm leaves.

A. L. S.

Epiphytic Lichens.—F. OCHSNER ("Studien über die Epiphyten-Vegetation der Schweiz," *Jahrb. St. Gall. Naturw. Gesell.* [1927] 1928, **63**, 1-108, 15 text-figs.). In this study of epiphytes, lichens play a large rôle. The author deals with 280 species, of which 130 are obligate epiphytes; the others may also grow on rock or other substratum. Rough and smooth bark harbour different types of lichens. On the latter, crustaceous species predominate. The orientation of the trees is also important. They adhere to the trees by rhizine, etc., which do not penetrate to the living tissue. Epiphytes are nourished partly by the dead bark material. Factors such as temperature, light, and moisture are of great importance to their occurrence. Ochsner proceeds to an examination of different trees with the epiphytes on each, and gives a complete list of epiphytic lichens observed. Later he takes up the question of associations. Thus a *Lecanorion subfuscae* has, as the most important associates, *Lecanora subfusca* and *Lecidea parasema*. With these

occur *Pertusaria communis*, *Phlyctis argena* and *Ph. agelæa*, along with other *Lecanoræ* which are allied with *L. subfusca*. Many other important associations are defined, as, for instance, *Usneetum barbatae*, which occurs at its best at heights of 1,000–1,500 m., and includes several *Usnea*, *Alectoria jubata*, *Letharia divaricata*, with several *Parmeliæ* and *Cetraria glauca*. As a type of succession he cites *Lobarietum pulmonariæ*, which is best developed in Switzerland at an altitude 1,200–1,300 m. Lichen growth in that association begins with *Phlyctis argena* and *Graphis scripta*, later arrives *Lobaria pulmonaria*. He considers it to be a typical Atlantic association. A final note is given on the harm done by epiphytes. They induce moist conditions and encourage the growth of bacteria and fungi which may penetrate the living tissue. To correct this the growths can be removed by scraping and by a wash of lime. A. L. S.

Rock Lichens of the Ukraine.—A. N. OXNER ("Zur Kenntnis der Flechtenflora an Austretungen festen gesteins in der Ukraine," *Bull. Jard. Bot. Kieff*, 1927, 5–6, 23–81, 1 text-fig., Russian with German *résumé*). The author has dealt with lichens on firm rock (chalk, granite). He gives his views on the definitions of species, variety, and form. The paper is largely occupied with ecological questions. A. L. S.

Lichen Formations of Pine Forests.—P. N. NIKOLSKY ("Lichen Formations in the Pine Forest of Medvedok," Russian with English summary, *Bull. Jard. Princ.*, 1928, 27, 605–18). The Medvedsky pine forest is on sandy ground in the Wjalka Government (N.E. Russia). A survey of the lichen flora on pine trees in four selected areas is given, and the lichens that occurred are listed in tables. Nikolsky dealt with 77 species. These were most numerous in the "*Pinetum cladinosum*" group, and among them *Evernia thamnodes* and *Parmelia physodes* bulk most largely. The trees were all conifers, with the exception of *Populus tremula*, on which a few of the lichens were also found. *Anaptychia speciosa* grew only on *Populus tremula*, and *Physcia stellaris* only on *Pinus silvestris*. A. L. S.

Growth of Lichens.—T. A. TENGWALL ("Renlavarernas Tillväxt och Biologi i Torne och Lule Lappmarker," *Svensk Bot. Tidsk.*, 1928, 22, 18–32, Swedish with German *résumé*). The author has watched and calculated the rate of growth of reindeer lichens during a period of five years (1914–19). He found that the rate of increase of small individuals is the same as for larger forms, but some fully-grown species did not increase, having, he considers, reached their maximum height (45–65 mm.). He has calculated, from his observations, that *Cladonia alpestris* requires 30 to 45 years to attain 60 mm., that *Cl. rangiferina* reaches the same height in 15 to 20 years, *Cl. silvatica* in 20 to 30 years. As for other members of the group, *Cladonia uncialis* grew rather quickly. *Stereocaulon* would require 15 years to reach 50 mm., its greatest height. Thus a lichen sward would require 15 to 30 years for regeneration, and *Stereocaulon* may be reckoned as a pioneer in colonisation. It grows in small hollows and damp places, and is able to push out other *Cladoniæ*. A. L. S.

Gall Formation in Cladoniæ.—E. BACHMANN ("Die Pilzgallen einiger Cladonien. IV. Blattgallen und beblätterte Gallen," *Arch. Protistenkunde*, 1928, 64, 109–51, 44 text-figs.). Bachmann gives a long and detailed account of the reactions of the primary thallus of *Cladoniæ* owing to fungus attacks. He found galls due to insect agency on *Cl. ochrochlora*, but these will be considered elsewhere. "Leaf"-forming galls due to fungi are described on *Cladonia degenerans* f. *phyllophora*, *Cl. gracilis*, and *Cl. pityrea* f. *hololepis*. The fungus attack of these three

species is both on podetia and primary thallus, mostly on the under surface, as the cortical tissue is thinner and more easily penetrated than that of the upper surface. The galls formed take frequently a "horseshoe" shape, and the formation of "leaflets" is induced. Sometimes only small warts are formed, or distortions of the lichen structures. Bachmann has traced the penetration of the fungus hyphæ and its effect on medulla and gonidia. These latter are degenerate or empty. Those nearer the cortex may be still healthy; those in contact with the fungus are wholly absorbed. A noteworthy point is that "leaflets" that form on the galls do so owing to remnants of gonidial groups taking on new developments. A. L. S.

Anatomy of Collema.—M. M. HOLLERBACH ("Einige Nachträge zur Anatomie der Wasserflechten *Collema* (?) *Ramenskii* Elenk.," *Bull. Jard. Bot. Princ.*, U.S.S.R., 1928, 27, 306-13, 1 pl., Russian with German *résumé*). The gonidia of this deeply immersed aquatic *Collema* forms in the thallus a curious condition (*Kokkoidstadium*) of *Nostoc Zetterstedtii*. The writer observed the formation of gelatinous substance in the masses of gonidia, and the development of gonidial groups in the lichen thallus. The hyphæ form oil swellings. The cortex and rhizoids which are formed at contact points of the lichen with the substratum were also studied. A. L. S.

Collemaceæ of Toulon.—A. DE CROZALS ("Essai sur les Collémacées des environs de Toulon," *Ann. Soc. Hist. Nat. Toulon*, 1927, 16-73). The author has made a detailed study of this family, following Hue in the classification. He has increased the list of Toulon members of the family from 7 species to 77, more than half of those recorded for France. It follows that Collemaceæ are, on the whole, plants of warmer regions. A. L. S.

Lichen Symbiosis in Bæomyces.—F. TOBLER ("Zur Kenntnis der Flechtensymbiose und ihrer Entwicklung," *Ber. Deutsch. Bot. Ges.*, 1928, 46, 220-34, 1 col. pl., 7 text-figs.). The genus *Bæomyces* has been distinguished from *Cladonia* in that the stalk has been considered in most species to be free from gonidia, thus showing a lack of balance between the two symbionts. Tobler has made a careful study of *Bæomyces roseus* both in the field and in the laboratory. Stalks partly deprived of the apothecia at the tips began to reform the fructification. Portions of the stalks supplied with gonidia formed stalks with the usual phototropic reaction. The gonidia were found to be immersed in the stalk in close relation with the hyphæ, and there arose a type of podetial stalk resembling that of *Cladonia*, though, in normal circumstances of growth, the "*Bæomyces* type" of stalk prevails, and in no instance is a regular zone of gonidia formed, they always occur in clumps. The genus had been divided into two sections according to the presence or total absence of gonidia, a division that no longer holds good. A. L. S.

Lichen Gonidia.—OTTO JAAP ("Nouvelles recherches sur les gonidies des Lichens," *Compt. rend. Soc. Phys. Hist. Nat. Genève*, 1928, 45, 28-32). Jaap has experimented with gonidia from species of *Verrucaria*, *Solorina* and *Cladonia*, and also from *Parmelia caperata* taken from an oak and from an apple tree. The gonidia from the latter forms belonged to *Cystococcus* and were morphologically similar, but in cultures they showed considerable differences in colour and form of the culture, representing, according to Jaap, two distinct sub-species. As to multiplication of the gonidia, he found not only autospores, but copulation of gametes and zoospores. The gametes were elongate with two cilia, many issuing from one cell: they may issue as a somewhat gelatinous mass from the mother-cell, or they may be already active before emergence and scatter when set free. The zoospores are somewhat similar to the gametes, but do not fuse. A. L. S.

Lichen Gonidia.—ROBERT PAULSON ("The Gonidium Common to Many Lichens," *Trans. Brit. Mycol. Soc.*, 1929, 14, 135-9, 1 pl.). The author gives a short history of the views held as to the nature and identity of the common lichen gonidium. Recently Puymaly has redescribed it, and placed it in a new algal genus, *Trebouxia*. Much depends on the appearance of the chromatophore. Puymaly describes it as of irregular or stellate outline, following in this respect Chodat and others. Paulson has contested this description. He finds that the outline of the chromatophore is round and smooth, and justifies his contention by careful and skilful microphotography. The aspect of minute objects changes with the focus, but exact observation gives the unbroken outline, and the description of *Trebouxia* does not agree with these observed and proved facts. A. L. S.

Cultures of Lichen Hyphæ.—R. G. WERNER ("Influence du milieu sur la croissance des champignons de lichens," *Compt. rend. Acad. Sci. Paris*, 1927, 185, 1149-51). Werner gives results of his cultures of lichen hyphæ on various agar culture media. He found the best adapted to his purpose were 3 p.c. malt glucose or agar (Waren formula). He made comparative cultures of 1 mm. of the thallus of a number of the larger lichens—*Gyrophora*, *Parmelia*, *Xanthoria*, *Usnea*, etc. He found that growths were advanced by 1 p.c. glucose, and retarded to the lowest by the addition of urea. On the whole they grow best on malt agar without glucose. At the same time the mycelium preferred glucose to galactose. *Sticta* alone grew well with urea. When algæ were added to the culture, the green cells grew more rapidly than the hyphæ, which, on the whole, developed more slowly than when alone. A. L. S.

Conidia of Lichens.—R. G. WERNER ("Sur la multiplication par conidies dans les cultures pures des champignons de lichens," *Compt. rend. Congrès Soc. Sar. Poitiers* (1926), 1927, 113-5). In this paper Werner outlines his account of cultures made with spores of several lichens. In a *Cladonia squamosa* culture, after a "dome" of hyphæ was formed, conidiophores on the surface produced conidia. He found similar developments in cultures of species of *Xanthoria*, *Rumalina*, *Parmelia*, *Usnea* and *Gyrophora*. From the conidia new colonies arose in the cultures (most abundant in *Gyrophora erosa*). On other hyphal cultures pycnidia were formed resembling those of the symbiotic thallus. A. L. S.

Reproduction in Lichens.—M. and MME. FERNAND MOREAU ("Les phénomènes cytologiques de la reproduction chez les champignons des lichens," *Le Botaniste*, 1928, sér. 20, fasc. i-ii, 1-67, 35 text-figs.). The authors here set out the results of long work on the origin of the ascus in lichens. They distinguish definitely two types: I. The *Collema* type, in which the ascogonium consists of long continuing uninucleate cells and an ephemeral multinucleate condition. Not all the cells become multinucleate. The ascogenous hyphæ are uninucleate; later, by possible cell-fusion, two nuclei are found together, but not immediately followed by nuclear fusion, and asci arise from these cells. Nearly all the lichens examined belong to this type of development. II. The *Peltigera* type, with which is associated *Solorina*. In these a multinucleate condition of the ascogonial cells arrives at an early stage, and the ascogenous hyphæ are also multinucleate. By cell divisions these hyphæ are divided into binucleate cells. The authors compare these developments with those of Ascomycetes and Basidiomycetes. They find no reason to accept fertilisation by spermatia and no connection of the so-called trichogyne with that of the *Florideæ*. A. L. S.

Mycetozoa and Plasmodiophorales.

Recent Additions to Mycetozoa.—HANS SCHINZ ("Plasmodiophorales und Myxogasteres," *Ber. Schweiz. Bot. Gesell.*, 1928, **37**, 67–70). Schinz draws special attention to the genus *Kleistobolus*, and gives the relations to the allied genera *Licea*, *Hymenobolina*, and *Orcadella*. Notes are given on the status of several species as published by workers in this group. A. L. S.

Feeding Habits of Mycetozoa Swarm Cells.—FRANK A. GILBERT ("Observations on the Feeding Habits of the Swarm Cells of Myxomycetes," *Amer. Journ. Bot.*, 1928, **15**, 473–84, 2 pls.). The writer has found that the swarm cells of mycetozoa ingest not only bacteria, but also the spores of fungi such as those of Agaricaceæ, Mucorales, Discomycetes, and lignicolous Fungi Imperfecti. Great variation was found, however, in the readiness with which the fungus spores were ingested. *Leocarpus fragilis*, *Didymum* sp., *Stemonitis* sp., and others ingested spores of almost any of the fungi experimented with, provided that they were not too large. Other mycetozoa—*Fuligo septica*, *Stemonitis fusca*, *Arcyria denudata*, etc.—did not take in spores to so large an extent, possibly, the writer concludes, because the swarm cells in culture spent most of their time in the rotating stage, during which ingestion did not take place. With few exceptions, no single mycetozoon showed special liking for spores that were not taken to a greater or less degree by other members. The ability to ingest spores was specific and not a characteristic of any family or genus. A. L. S.

Spore Germination in Mycetozoa.—FRANK A. GILBERT ("A Study of the Method of Spore Germination in Myxomycetes," *Amer. Journ. Bot.*, 1928, **15**, 545–52, 2 pls.). Gilbert studied germination in 56 representative species of myxomycetes collected in New England. The spores were sown in distilled water. He noted two distinct methods of germination—one, as in *Fuligo septica*, in which the swarm cell escapes through a deep wedge-shaped structure in the spore wall; the other in which the swarm cell emerges through a small jagged aperture in the spore wall, as in *Dictydiothallium plumbeum*. In the first case emergence is secured by rupture of the wall through internal pressure of the swelling protoplast; in the second by the softening of the wall substance by enzyme action. The Calcarineæ appear to germinate by the wedge-shaped aperture. Of the 18 species observed, 9 emitted one to four swarm cells from the normal spore. *Leocarpus fragilis*, for instance, was observed to give rise regularly to from one to four swarm cells. A. L. S.

Study of Sorosphæra.—W. R. IVIMEY COOK and E. J. SCHWATZ ("The Life-History of *Sorosphæra radicale* sp. nov.," *Ann. Bot.* 1929, **43**, 81–8, 1 pl.). The fungus was found infesting the roots of a number of grasses in marshes and damp meadows in the neighbourhood of Dunton Green, Kent, and also elsewhere. The parasite was proved, after careful study, to be undoubtedly a member of the Plasmodiophorales, and was assigned to the genus *Sorosphæra*, closely allied to *Lagniera*. The spores are formed in sori in the cells of the root-hairs, and are cinnamon in colour. The nuclear divisions during the growth of the plasmodium are protomitotic; those immediately prior to spore formation are apparently meiotic. A diagnosis is given of the genus and of the new species. A list of literature on the subject completes the paper. A. L. S.

TECHNICAL MICROSCOPY.

A New Type of Microscope Lamp.—C. E. JENKINS (*J. Path. & Bact.*, 1929, 32, 340). A new type of lamp has been designed in which the Dakol light filter has been incorporated. A 150-watt gas-filled lamp of clear glass is employed, and behind this is a reflector of polished metal which is a segment of a cylinder. The Dakol filter is placed at an angle of 45° to an opal glass, behind which is a glass mirror by which the light is reflected back for dispersal on the matt surface of the opal glass, thus increasing the luminosity. As the lamp is wedge-shaped, the microscope can be placed close up, and at the same time there is room for free manipulation of the instrument with both hands. The quality of the illumination is good, colour rendering is accurate, definition is improved, and eyestrain is much decreased. G. M. F.

Maceration Method in Microscopical Examination of Coal.—H. BODE (*Berg. Technik*, 1928, 21, 205, *through Brit. Chem. Abstr. B*, 1929, 230). In order to distinguish the degree of coalification, and the presence of vitrain, durain and fusain in coal, the sample is first oxidised with Schultze's solution—a solution of potassium chlorate in nitric acid, whereby coalification products of cellulose and lignin are removed, leaving the cellulose and bituminous products unattacked. A. H.

Microscopic Observations on Graphite and Coke.—P. RAMDOHR (*Arch. Eisenhüttenw.*, 1928, 1, 669–72, *through Chem. Abstr.*, 1929, 1738). The characteristic of graphite, when examined under the ore microscope (oil immersion), is the extraordinary pleochromism, while the anisotropic effect is unusually strong. A microscopical study of coke formation is recorded, illustrated by 20 photographs. A. H.

NOTICES OF NEW BOOKS.

Index Animalium.—By C. D. SHERBORN. 1928. Part XV, pp. 8747–3970. Part XVI, pp. 3971–4194. Published by the British Museum (Natural History), Cromwell Road, London, S.W.7. Price 10s. each part.

Bacteriology: A Text-book of Micro-organisms.—By FRED WILBUR TANNER. 1928. xvii, 548 pp., 138 text-figs., 1 plate. Published by John Wiley & Sons, Inc., New York, and Chapman & Hall, Ltd., 11, Henrietta Street, Covent Garden, London, W.C.2. Price 22s. 6d.

Elektrizität und Eiweisse, insbesondere des Zellplasmas.—By Dr. HANS PFEIFFER. 1929. xii, 149 pp., 7 text-figs. Published by Verlag von Theodor Steinkopff, Dresden and Leipzig. Price RM.11.50.

Science in the Netherlands East Indies.—Edited by L. M. R. RUTTEN. 1929. viii, 432 pp., 5 plates, 93 text-figs. Published by the Koninklijke Akademie van Wetenschappen, Amsterdam.

Microscope Record.—No. 17. May, 1929. 32 pp., 8 text-figs. Published gratis by W. Watson & Sons, Ltd., 313, High Holborn, London, W.C.1.

Faune de France.—Vol. 20. Coléoptères: *Cerambycidae*. By F. PICARD. 1929. vii, 168 pp., 71 text-figs. Published by Paul Lechevalier, 12, Rue de Tournon, Paris. Price 32 fr.

Handbook of Microscopical Technique.—Edited by C. E. McCLUNG, Ph.D. 1929. xiv, 495 pp., 43 text-figs. Published by Paul. B. Hoeber, Inc., New York, and Humphrey Milford, Oxford University Press, Amen House, Warwick Square, London, E.C.4. Price 36s.

The present work, which is a companion volume to the text-books of General and Special Cytology edited by Dr. E. V. Cowdry, purports to give the methods involved in cytological and allied work. Twenty-three contributors are associated with the general editor. The section on micro-dissection and micro-injection, by Dr. Chambers, is of particular interest. The other sections are of somewhat unequal value. Bacteriological, botanical, protozoological, embryological and histological methods are all dealt with. There is unavoidably much overlapping and, what is perhaps more annoying, many cross references which are inadequately covered by the index. There are also numerous errors in the index, e.g. "Mitochondria, in Protozoa, methods for," refers to page 309, which deals with the demonstration of Krause's membrane and striated muscle. Feulgen's technique, which first saw the light in 1924, can hardly be called recent; it just slips in under the heading "Miscellaneous" on the last two pages. The book would have been greatly improved by more intensive editorial control and by the provision of an adequate index.

G. M. F.

PROCEEDINGS OF THE SOCIETY.

AN ORDINARY MEETING

OF THE SOCIETY WAS HELD AT 20, HANOVER SQUARE, W.1, ON WEDNESDAY, MARCH 20TH, 1929, DR. JAMES A. MURRAY, F.R.S., VICE-PRESIDENT, IN THE CHAIR.

The Minutes of the preceding Meeting were read, confirmed, and signed by the Chairman.

New Fellow.—The following candidate was balloted for and duly elected an Ordinary Fellow of the Society :—

Charles Wilson Peck.

The Nomination Certificate in favour of the following candidate was read for the first time and ordered to be suspended in the Rooms of the Society in the usual manner :—

Frank David Armitage, Denham.

A Donation was reported from :—

The Trustees of the British Museum—

“ Index Animalium.” Parts XV–XVI. (Sherborn.)

A vote of thanks was accorded to the donors.

Exhibit.—Mr. Conrad Beck exhibited and described *Pleurosigma angulatum* resolved in monochromatic light with an 8 mm. apochromatic objective, .65 N.A., and dry dark-ground illuminator, 0.8 angular aperture, x17 eyepiece.

Paper.—The following paper was read in title :

Mr. R. N. Mukerji, M.Sc.—

“ Later Stages in the Spermatogenesis of *Lepisma domestica*.”

A **discussion** was then held on Dr. Moore's paper on "The Mode of Formation of the Image in the Microscope," in which the following contributors took part :—

Captain M. A. Ainslie, R.N., F.R.A.S.—

"Notes on the Abbe Theory."

Mr. Conrad Beck, C.B.E., F.R.M.S.—

"Notes on the Abbe Theory."

Dr. M. Berek—

"On the Extent to which Real Image Formation Can Be Obtained in the Microscope."

Dr. A. S. Burgess, M.A., M.D., F.R.M.S.—

"Note on Resolution with Dark-field Illumination."

Mr. J. W. Gordon, K.C.—

"Notes on the Abbe Theory."

Sir Herbert Jackson, K.B.E., F.R.S.—

"Notes on the Abbe Theory."

Mr. B. K. Johnson, F.R.M.S.—

"Note on the Abbe Theory."

Dr. H. Moore, A.R.C.S., D.Sc., F.Inst.P.—

"Further Contribution on the Mode of Formation of the Image in the Microscope."

Professor A. W. Porter, F.R.S.—

"Formation of Images and the Resolving Power of Microscopes."

Mr. Julius Rheinberg, F.R.M.S.—

"The Mode of Formation of the Image in the Microscope."

Professor H. F. W. Siedentopf—

"On the Quality of the Image and Resolving Power."

Votes of thanks were accorded to the authors of the foregoing communications and to Mr. Beck for his exhibit.

The Chairman announced that the Biological Section would meet in the Library on April 3rd, 1929, at 7.30 p.m.

The proceedings then terminated.

AN ORDINARY MEETING

OF THE SOCIETY WAS HELD AT 20 HANOVER SQUARE, W.1, ON WEDNESDAY, APRIL 17TH, 1929, MR. JOSEPH E. BARNARD, F.R.S., PRESIDENT, IN THE CHAIR.

The Minutes of the preceding Meeting were read, confirmed, and signed by the President.

New Fellow.—The following candidate was balloted for and duly elected an Ordinary Fellow of the Society :—

Frank David Armitage.

On the invitation of the President, Mr. Charles Wilson Peck, who had been elected at the previous Meeting, came forward and appended his signature to the Roll of Fellowship, and was duly admitted a Fellow of the Society.

The Nomination Certificates in favour of the following candidates were read for the first time and ordered to be suspended in the Rooms of the Society in the usual manner :—

Eric L. E. Humphriss, Liverpool.

Rashid A. Munshi, Bangor.

Joseph M. Thüringer, Oklahoma.

Donations were reported from :

Messrs. Chapman & Hall—

“ Bacteriology : A Text-book of Micro-organisms.” (Tanner.)

Verlag von Theodor Steinkopff—

“ Elektrizität und Eiweisse, insbesondere des Zellplasmas.” (Pfeiffer.)

Votes of thanks were accorded to the donors.

The Treasurer presented the Balance Sheet and Financial Report for the year 1928.

FINANCIAL REPORT FOR THE YEAR ENDING

31ST DECEMBER, 1928.

The Income and Expenditure Account for the year shows a balance of income over expenditure of £2 1s. 4d. This amount, deducted from the debit balance of £104 5s. 1d. brought forward, leaves a balance of £102 3s. 9d. to the debit of Income and Expenditure Account.

There is no change in the Life Membership Account, which stands at £1,884 10s.

The Investment Account remains at £1,969 10s. 5d., the market value at 31st December, 1928, being £2,292 10s. 6d.

Sales of surplus books and periodicals from the Library realised £34, and this has been credited to Capital Account, making the amount under this heading £222 12s.

An amount of £468 12s. 11d. has been expended on the publication of "The Microscope and Catalogue of Instruments," and the sales to date amount to £109 2s. 3d.

Turning to the Income and Expenditure Account, the Society has spent £34 on the Library, which has been completely reorganised during the past year, and the publication of the new catalogue is now in hand.

The cost of the Journal has increased by £78, and a publication grant of £100 has been received from the Royal Society.

During the year a "Complete Index to the Diatomaceous References in the Society's Journal, 1853-1915," has been published at the cost of £60. This amount has been included in expenditure on the Journal, and sales are credited thereto. A donation of £20 has been received towards this work.

Compared with last year, the income of the Society shows a slight increase, the amount received from admission fees being higher, and the Journal sales have increased, but the amount received from subscriptions has again declined.

On the expenditure side there is a considerable reduction, which is mainly accounted for by the decreased administration expenses, and it should be noted that £50 of the amount reserved in the previous year in respect of a doubtful debt has been written back.

The number of Fellows on the Roll of the Society at 31st December, 1928, is as follows :—

Number of Fellows on the Roll of the Society at 31st December, 1927	.. .. .	513
Ordinary Fellows elected or reinstated during the year	..	42
		<hr/>
		555
Resigned or removed during year	.. .. . 34	
Deceased during year	.. .. . 8	
		<hr/>
		42
		<hr/>
		513

The total is made up of :—

(a) Ordinary Fellows	.. .. .	470
of whom 418 have paid their subscriptions		
,, 26 are in arrear		
	<hr/>	
	444	
26 are two years in arrear		
	<hr/>	
	470	
	<hr/>	
(b) Life Fellows	.. .. .	29
(c) Honorary Fellows	.. .. .	14
		<hr/>
		513

Mr. Hill moved, and Mr. A. W. Sheppard seconded :—

“ That the Financial Report be received and adopted.”

Carried.

Mr. Conrad Beck moved, and Mr. Joseph Wilson seconded, the following resolution, which was carried unanimously :—

“ That the appreciation and thanks of the Society be conveyed to Messrs. Thomson McLintock & Co., Chartered Accountants, for their generous services to the Society as Honorary Auditors during the past year.”

Exhibit.—Messrs. Beck exhibited an efficient and inexpensive microscope for school purposes, which was described by Mr. S. Borthwick.

The following communications were read and discussed :

P. L. Li, M.B., H. S. D. Garven, B.Sc., M.D., and R. Howard Mole, B.A., M.D.—

“ The Microscopic Anatomy of the Vascular System of the Dog's Spleen.”

D. S. Spence, M.B.—

“ A Method of Finding the Refractive Index of a Drop of Mounting Medium.”

The following paper was read in title :—

Professor E. Ghosh, M.Sc., M.D., F.Z.S., F.R.M.S.—

“ Two New Suctoria from Sewer Water.”

Votes of thanks were accorded to the authors of the foregoing communications and to Messrs. R. & J. Beck for their exhibit.

The President announced that the Biological Section would meet in the Library on Wednesday, May 1st, 1929, at 7.30 p.m.

The proceedings then terminated.

FOR YEAR TO 31st DECEMBER, 1928.

Cr.

Dec. 31, 1927.

£	s.	d.		£	s.	d.	£	s.	d.
856	18	10	By Subscriptions	795	8	1			
			„ Subscriptions for 1928 unpaid	46	18	0			
48	6	0	„ Admission Fees				842	6	1
0	11	3	„ Sundry Sales				73	10	0
100	11	10	„ Interest on Investments and Deposit Account				2	17	6
479	1	7	„ Balance, being Excess of Expenditure over Income				104	0	10

£1485 9 6

£1022 14 5

31st DECEMBER, 1928.

Cr.

	£	s.	d.	£	s.	d.
I. Furniture, Instruments, etc., as at 31st December, 1927.	234	15	2			
Additions during year	16	10	6			
				251	5	8
II. Investments				1909	10	5
£400 London & North Eastern Railway Co. 3% Debenture Stock.						
£500 Nottingham Corporation 3% Irredeemable Debenture Stock.						
£915 11s. 4d. India 3% Debenture Stock.						
£150 Metropolitan Water Board "B" Stock.						
£612 London Midland & Scottish Railway Co. 4% Preference Stock.						
£200 New South Wales 5½% Loan 1947-57.						
£421 1s. 5% War Loan, 1929-47.						
Note.—The Market Valuation of the above Investments at 31st December, 1928, was £2,292 10s. 6d.						
III. "The Microscope and Catalogue of Instruments"—Amounts expended on publication to date	468	12	11			
Less Sales	109	2	3			
Note.—The Hon. Treasurer of the Society has given his personal guarantee to meet any part of this expenditure that is not recovered by means of sales of the publication.				359	10	8
IV. Sundry Debtors—						
Subscriptions Unpaid	46	18	0			
On account of Journal Sales	24	15	3			
On account of Advertisements, etc.	134	19	11			
Suspense Account	200	0	0	406	13	2
V. Cash—						
At Bank—on Current Account	19	5	7			
In hand	0	1	10			
VI. Income and Expenditure Account—				19	7	5
As at 31st December, 1927	104	5	1			
Less: Excess of Income over Expenditure for the year ended 31st December, 1928	2	1	4			
				102	3	9
				£3108	11	1

a true and correct view of the state of the Society's affairs, subject to it being noted that no account has been taken of the value of the Society's Library and Stock of Journals (valued for insurance, together with the Furniture, Instruments, etc., at £4,600).

(Signed) THOMSON McLINTOCK & CO.,
Chartered Accountants, Hon. Auditors.

71, Queen Street, E.C. 4.

AN ORDINARY MEETING

OF THE SOCIETY WAS HELD AT 20 HANOVER SQUARE, W.1, ON WEDNESDAY, MAY 15TH, 1929, MR. JOSEPH E. BARNARD, F.R.S., PRESIDENT, IN THE CHAIR.

The Minutes of the preceding Meeting were read, confirmed, and signed by the President.

New Fellows—The following candidates were balloted for and duly elected Ordinary Fellows of the Society :—

Eric L. E. Humphriss.

Rashid A. Munshi.

Jos. E. Thüringer, M.D.

The Nomination Certificate in favour of the following candidate was read for the first time and ordered to be suspended in the Rooms of the Society in the usual manner :—

Professor Francisco Medina, Mexico.

Donations were reported from :

Mr. Arthur Earland, F.R.M.S.—

Collection of Fifty Slides of Foraminifera.

Mr. E. Heron-Allen, F.R.S., F.R.M.S., and Mr. Arthur Earland, F.R.M.S.—

Two Paratype Slides of Foraminifera from the Discovery Expedition 1925-1927.

Mr. J. Richardson, F.R.M.S.—

Micro Slide of "Fairy Beetle"—*Trichopterygidae atomaria*.

Koninklijke Akademie van Wetenschappen, Amsterdam—

"Science in the Netherlands East Indies."

Votes of thanks were accorded to the donors.

The Death was reported of :—

Alfred N. Disney. Elected 1886.

The Fellows expressed their condolence with the relatives by standing in silence.

Exhibit.—Mr. D. J. Scourfield exhibited a field box microscope which he described as a modification of a pocket lens shut up into a small box with open top, the lens being at one end with flaps at either side to exclude adventitious light from the eye. The lens is provided with spiral focusing adjustment, and either plant or pond-life organisms examined in a small tank or tube appear on a velvety black background. Provision is made for changing lenses of varying magnification.

Papers.—The following paper was then read :

Mr. E. Heron-Allen, F.R.S., F.R.M.S., and Mr. Arthur Earland, F.R.M.S.—

“ Some New Foraminifera from the South Atlantic. I.

In the discussion that followed, Dr. Stanley Kemp expressed his high appreciation of the authors' remarks as to the good state of preservation of the material collected. He observed that it is becoming increasingly difficult to get specialists in the different groups to devote the necessary amount of time in the working out of the various collections, and he was indebted to Mr. Heron-Allen and to Mr. Arthur Earland for the immense amount of time they had devoted on this particular group upon which they were such distinguished authorities.

Mr. Barnard referred to the method of producing the skiagraphs of the specimens exhibited, and expressed the opinion that by the use of tubes of varying hardness it would be possible to obtain a successive series of photographs which would give still further information as to the internal arrangement of such structures as foraminifera, and, in addition, would be a guide as to the variation of the material used in the structure of the test. He was of opinion that this method had not been sufficiently considered as a possible and fruitful source of information in the study of these structures.

The President then having to leave the Meeting, called upon Dr. Murray, Vice-President, to take the Chair.

The Chairman then called upon Mr. Robert Paulson, F.L.S., F.R.M.S., to deliver his communication on :—

“ The Form of the Chromatophore of the Bright Green *Gonidium* common to many Lichens.”

The following paper was read in title :

Mr. David Bryce, F.R.S.E., F.R.M.S.—

“ On Three Cases of Encystment Among Rotifers.”

Votes of thanks were accorded to the authors of the foregoing communications, to Mr. Scourfield for his exhibit, and to Messrs. E. Leitz for the loan of microscopes.

The Chairman made the following announcements :—

The next Ordinary Meeting of the Society will be held on ‘Wednesday, October 16th, 1929, when the Annual Pond Life and General Microscopical Exhibition will be held.

The next Meeting of the Biological Section will be held on Wednesday, November 6th, 1929.

Summer Vacation.—The Rooms of the Society will be closed for the Summer Vacation from August 19th to September 14th, 1929.

The proceedings then terminated.

Journal of the Royal Microscopical Society. Series III. Vol. XLIX. Part 3.

September 1929.

ERRATUM.

Page 211, line 8. After *Communicated by* read

Professor R. RUGGLES GATES, F.R.M.S., *May 15, 1929.*

JOURNAL
OF THE
ROYAL MICROSCOPICAL SOCIETY.
SEPTEMBER, 1929.

TRANSACTIONS OF THE SOCIETY.

XIV.—MEIOSIS IN *RUMEX PULCHER* L.

By TAMAKI SHIMAMURA.

(Communicated by Professor J. BRONTÉ GATENBY, F.R.M.S., May 15, 1929.)

THREE PLATES.

THE cytological studies of *Rumex* made by Kihara and Ono (1926) and Jaretsky (1928) suggest that the number of chromosomes in the species of the subsection *Eulapathum* exhibit various multiples of the fundamental haploid number of chromosomes, as 10 is the fundamental haploid number, and species were found having 20, 30, 40, 50, 60 or 100 chromosomes.

The following study of the meiotic divisions in *Rumex pulcher* L. confirms the conclusion that this species, which belongs to *Eulapathum*, has 10 chromosomes as the haploid number in the pollen mother-cells.

The material studied was collected from Kew Gardens in the middle of June, 1928, the fixing fluids being Allen's modification of Bouin's fluid and Carnoy solution (with chloroform). To ensure quick penetration of the fixative, a hand air-pump was used in both cases. The latter gave better results, and the following description is based on the material fixed in Carnoy solution unless otherwise stated. Collections of material were usually made between 12 a.m. and 1.30 p.m. on bright sunny days. Owing to the fact that the material had to be taken some distance from the Botanical Gardens to the laboratories, it was impossible to keep the exact time of fixation constant. The time of fixation was between one and two hours.

After dehydration and clearing, the material was embedded in paraffin wax and sectioned at a thickness of 12 or 14 μ . Heidenhain's iron-alum hæmatoxylin was used as the stain, and gave good results.

OBSERVATIONS.

In later prophase the pachynema threads extend more or less uniformly throughout the nucleus and are seen to be considerably thickened; at this time a number of double threads may appear frequently, as shown in figs. 1 and 2.

Since a double thread may arise from an approximation as well as a split, the mere presence of double threads is therefore not sufficient to provide a proof of parasynapsis. But still it is evident that double threads are present in later prophase. Sinotô (1924) has described the synapsis of chromosomes in *Rumex acetosa* as telosynaptic, while Kihara (1927) described it in *Rumex acetosella* as parasynaptic. It is difficult at present to state which is the mode of synapsis in *Rumex pulcher* until more is known of the process of meiosis in earlier stages such as leptonema and synizésis. In early diakinesis all the chromosomes become paired, therefore there are no univalent chromosomes. The bivalent chromosomes assume various forms; the commonest forms are those of 0 and 8. The chromosomes show neither the form of one or more chains nor rings of chromosomes, but take a lateral pairing. The ring-shaped lateral pairing is not assumed by every pair of chromosomes.

In fig. 3 some chromosome pairs twisted so closely that they look univalent, while other bivalents show ring-shaped structure or give the figure of eight.

Examination of the later stages of diakinesis frequently shows that each of the ten bivalent chromosomes is in a different stage of progress of condensation, some being already condensed and shaped in X-like form on short curved rods, while others are less condensed and the members of each pair are still apparent (fig. 4).

Immediately before the condensation takes place the chromosomes are distributed over the periphery of the nucleus just within the wall, as shown in fig. 5.

As the result of continued shortening and thickening, the chromosomes attain a compact form, presenting the haploid number. During the later stages the chromosomes become very compact, and finally appear as straight or curved rods, usually showing no indication of their bivalent nature (fig. 6).

It is possible that the swelling produced by the fixing fluid may obliterate the line of separation between the two halves of the gemini more completely than in the living condition, but in any case the relationship between the two halves is exceedingly close at this time.

The nucleus is bounded by a distinct membrane until the chromosomes are condensed to a firm outline and appear to have a greater staining power.

Shortly after the disappearance of the nuclear membrane, the achromatic

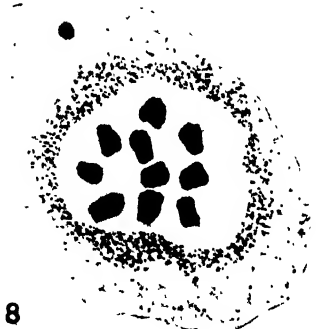
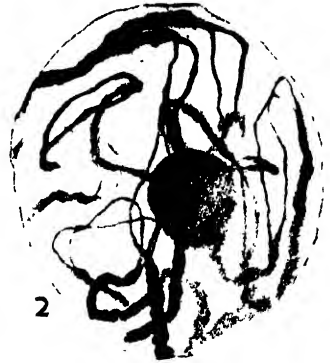
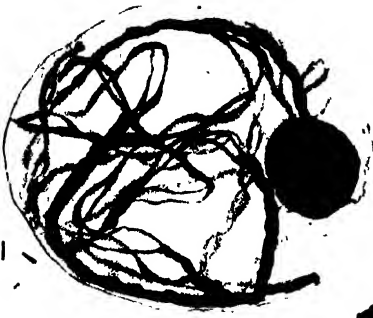




figure develops in the nuclear cavity, which is surrounded by a dense aggregation of cytoplasm (figs. 6, 7).

The observations on spindle formation in the present account reveal that the intra-nuclear origin is highly probable; but since the appearance of the nuclear membrane and achromatic figure depends in part on the fixative employed, it appears to the writer that special technique is necessary for the elucidation of these problems.

A large nucleolus which is well stained has been observed both in later prophase and in early diakinesis, but neither budding nor partial fragmentation have been observed. Sometimes two nucleoli are found, but additional smaller globules which seem to be derived from nucleolar fragmentation have not been observed.

At the time of disappearance of the nuclear membrane the nucleolus is still found in a vacuolate condition and very faintly stained. It is interesting to note that one or more well-stained small bodies appear not infrequently in the cytoplasm, even in the early diakinesis, and they have been observed almost constantly in the cytoplasm until heterotypic anaphase takes place (fig. 6).

Many cases show us that, although their origin is yet unknown, these extra-nuclear bodies exist before the disappearance of the large vacuolated nucleolus, and no other body appears either in the nuclear area or in the cytoplasm after the disappearance of the nucleolus.

When the bipolar spindle is formed, the bivalent chromosomes become grouped and are arranged on the equatorial plate of the spindle. They are condensed to a compact appearance; difference in length is not remarkable between them (figs. 8, 9). The nuclear area is still distinguishable from the surrounding cytoplasm, which seems to have specially dense granules. The polar view of this stage clearly shows the arrangement of chromosomes on the equatorial plate of the spindle (fig. 8). Ten bivalent chromosomes are counted. The material fixed in Allen's Bouin shows frequently nine chromosomes on the nuclear plate; this may be considered as the result of coalescence by fixation. As previously stated, no passage of nucleolar fragments from the nuclear area to the cytoplasm has been observed. In figures such as 9 and 10 a globule appears as if it lies within the spindle sheath, but in fact it is seen to be extra-nuclear in different focus.

In anaphase the 10 univalent chromosomes of each set proceed regularly towards the poles. Fig. 11 clearly shows equal distribution of the univalents to each pole.

Indication of the homœotypic split appears in late anaphase, just before the chromosomes reach the poles of spindle. The polar view of this splitting is shown by fig. 12.

On arrival of the 10 chromosomes at each pole of the heterotypic spindle in the side view they give the appearance of a compact mass (fig. 13), but in the polar view they show no fusion among themselves at this stage.

Fig. 14 represents an early interkinesis stage. The nature of each univalent

chromosome has been no more observed, although some of them show X's or V's shape. They gradually begin to anastomose. Considerable elongation of the chromosomes occurs during interkinesis, and they take up a peripheral position in the hyaline area ; one or more nucleoli may be seen at this stage (fig. 15).

In the homœotypic division, as in heterotypic, the chromosomes are gathered closely at the equatorial plate. In a comparison of this with the latter, the chromosomes are much smaller and have a much more elongated form. The space relationship of the homœotypic spindles is very variable ; two spindles are parallel in one plane or in two planes at an acute angle or at right angles to each other (figs. 16, 17, 18). As the chromosomes reach the poles, they are densely grouped and are very deep staining in character. No "lagging" chromosomes were observed (fig. 17).

Fig. 18 shows telophase, clear areas of nuclear sap appearing, and spindles are less defined. The four daughter-nuclei following the homœotypic mitosis take usually a tetrahedral arrangement.

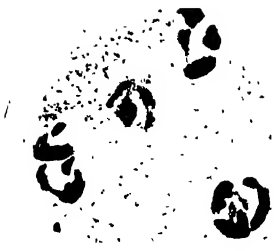
The clear area now increases considerably in size, and a membrane is formed delimiting the hyaline sap from the surrounding cytoplasm. Many globules of chromatin appear in this stage. The tetrad formation takes place exclusively by furrowing, and no cell plates have been found.

In *Magnolia Farr* (1918) stated that the cleavage furrows start to form after the heterotypic division, but their development is suspended until the end of homœotypic division.

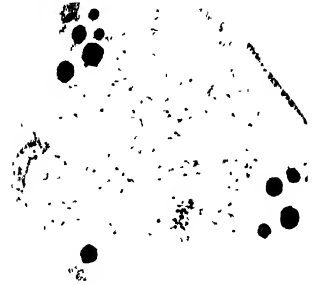
In *Rumex pulcher* the first evidence of the constriction generally has been found after the telophase of second division ; the cytoplasm is separated more or less from the cell wall, which has now a more thickened appearance than ever. Between the periphery of the cytoplasm and the thickened wall no specialised substance was found at this stage (fig. 19).

On the periphery of the cytoplasm constrictions appear at four points placed at equal intervals (fig. 20). The constrictions of the cytoplasm become progressively deeper ; they mostly show a shape like the cocoon of the silkworm, as in fig. 21. Finally the constriction furrows meet at the centre and cut up the protoplast into four spore cells. Sometimes the spindle fibres were still present in the process of constriction of the cytoplasm, but in no case were cell plates observed. While the centripetal development of the furrowing proceeds, the original cell wall increases in thickness, and looks very much as though it projected and followed the furrows inward. The source and manner of deposition of this thickening substance is not clear at all.

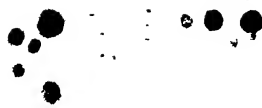
As the preparation which was observed had been treated only with Heidenhain's hæmatoxylin, it was therefore impossible to make accurate observations on the wedge-shaped thickenings of the heavy special wall which is considered to be a secretion from the cytoplasm, as was observed by Gates (1924) in *Lathræa*. After the progressive furrowing makes the four members of a tetrad separate from one another, the thickened walls,



18



20



19



21



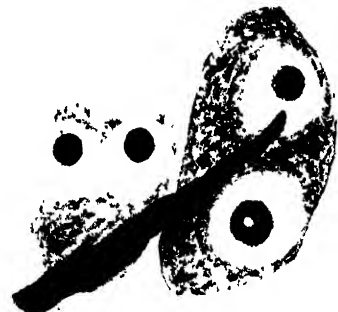
23



22



24



25

which have joined together at the centre of the tetrad, bind them together at first, as in fig. 22. This surrounding thick layer begins to dissolve when the newly differentiated cell membrane appears at the periphery of the protoplast of each member of the tetrad (fig. 23).

The appearance of a newly elaborated cell membrane and the dissolution of the thickened layer seem to occur almost simultaneously, these processes resulting in the liberation of the young pollen grains.

TAPETAL CELLS.

The tapetum cells in early stages, before the pachytene threads appear in the pollen mother-cells, have one large nucleus. They become binucleate by a mitotic division, and most of them remain in the binucleate condition. In later stages quadrinucleate cells were frequently observed. The nucleus in the binucleate condition has two or three large nucleoli, and a coarse reticulum occupies the nuclear cavity. In the cytoplasm between the nucleus and the periphery a large peculiar body has been observed; it is well stained with Heidenhain's hæmatoxylin, its shape much longer than the nucleus, more or less curved but not twisted, like a long and somewhat irregular rod (figs. 24, 25).

This body is found in the tapetum cells on every side of the locus, but not all tapetal cells have this body. The quadrinucleate tapetal cell also has this body, and at the time of mitotic division to form four nuclei the body may be observed by the mitotic figure. The material fixed in Allen's Bouin shows a clear canal in the cytoplasm. This fact reveals that the substance of the body dissolves out by fixation or treatment, and the body is not to be regarded simply as an artifact. Sugiura (1925) found in *Polygonum Savatieri* Nakai a structure something like this body: sometimes two are observed having a spirally twisted shape. He used Farmer's solution as a fixative. In *Fagopyrum emarginatum*, Jaretsky (1928) also found a structure very similar to this body in its shape. He regarded the structure as representing a Golgi apparatus, but there is very little evidence for this view at present.

It is difficult to say at present whether this body in *Rumex pulcher* L. has a definite relation to the development and growth of pollen grains. The writer expects that further investigation of the nature and origin of this body will bring this matter to light.

This work was carried out in the Botanical Department, King's College, University of London, under the supervision of Professor Ruggles Gates, to whom my best thanks are due for his kindly advice and valuable criticism.

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EXPLANATION OF PLATES.

All figures from the material fixed in Carnoy, except figs. 18 and 23, which are from the material fixed in Allen's Bouin.

All figures were drawn with the aid of a camera-lucida.

Figs. 1-4 were drawn under a 1/12 imm. Leitz. N.A. 1.30 with Zeiss Comp. oc. K. 20 ×. Magnification × 4,300.

Figs. 5-25 were drawn under a 1/12 imm. Leitz. N.A. 1.30 with Zeiss Comp. oc. K. 12. 15 ×. Magnification × 3,400.

Figs. 1-2.—Later heterotypic prophase showing double threads.

Figs. 3, 4.—Diakinesis showing 10 bivalent chromosomes.

Fig. 5.—Later diakinesis.

Figs. 6, 7.—Later diakinesis showing disappearance of the nuclear membrane. Two nucleoli are observed in fig. 6.

Fig. 8.—Heterotypic metaphase showing a polar view.

Fig. 9.—Heterotypic metaphase showing a side view.

Fig. 10.—Heterotypic anaphase.

Fig. 11.—Later heterotypic anaphase.

Fig. 12.—A polar view of one group of chromosomes at later anaphase showing homotypic splitting.

Fig. 13.—Heterotypic telophase.

Fig. 14.—Early interkinesis.

Fig. 15.—Later interkinesis.

Fig. 16.—Homotypic metaphase showing two spindles placed at right angles to each other.

Figs. 17, 18.—Homotypic telophase.

Figs. 19, 20, 21, 22.—Successive stages in the formation of the partition of tetrads.

Fig. 23.—Dissolution of the thick wall surrounding the tetrad. The cytoplasm of each microspore shrinks from the new cell wall.

Figs. 24, 25.—Tapetum cells in binucleate condition showing the peculiar body.

XV.—ON THREE CASES OF ENCYSTMENT AMONG ROTIFERS.

By DAVID L. BRYCE, F.R.S.E., F.R.M.S.

(Read May 15, 1929.)

ONE PLATE.

AT the November meeting of this Society I had the opportunity of showing to many of the Fellows present an example of the three-toed Bdelloid rotifer *Macrotrachela natans* Murray, wholly encased in a covering which appeared to have exuded from its own body and within which it had been seen to turn about in the early days of its encystment. The literature of the rotifera contains, to my knowledge, no single record of any species having being observed wholly to encase itself in this fashion, and as there is here a hitherto unknown resource of the animal, when it has need to be carried over a danger period, I have thought the matter of sufficient interest and importance to be brought forward in this paper, the more so, that this is the second occasion on which this procedure has come under my own observation. Furthermore, I am permitted, by the courtesy of my correspondent, M. de Koning, of Rotterdam, to add some particulars of another instance which was observed by him during the spring of last year.

My earlier case dates back to November, 1894, when I had not long started to restrict my study of the rotifera to the species comprised in the order of Bdelloida. I had already found that certain of the more important structural details of the majority of these forms could only be accurately examined when the animal was viewed from the dorsal side in the position assumed when feeding (i.e. when the corona was fully displayed), and when the rotifer is so assured of its safety that it remains quiet and does not move away out of the range of a $\frac{1}{4}$ -in. objective. When first isolated for close observation, the great majority of Bdelloids are so alarmed or excited that they swim or crawl about for a long time before they will settle down to feed quietly. For that reason I had made it my practice not to attempt any examination of the corona when a specimen was first isolated, but to defer that examination for one or more days, meanwhile keeping the live-cell in a damp chamber. I mention these details because in all probability this practice led directly to the two cases of encystment being observed by me, and, indeed, it is possible enough that only by such a method of deferred observation is there any appreciable chance of such cases being detected.

On the 18th November, 1894, I examined some moss collected at Deal during the preceding summer, since when it had been kept in a dry state

until opportunity came to deal with it. The moss had been soaked for a little time in water, and the sediment of the water had then been searched under a low power for what animal life had been hidden in the moss. Among other rotifers picked out was one which on first examination showed some peculiarities about the foot which interested me as being unusual. Without entering into details of these peculiarities, I need only state that the specimen had four toes, and would now be placed in the genus *Philodina*.

On the 21st November the rotifer was found in the live-cell in a retracted position not obviously differing from that commonly assumed by a *Bdelloid* when disturbed. Expecting that after a few minutes it would again extend itself, as mostly happens, I watched it, and presently saw it moving and turning itself about, as it were, within itself in a way that I did not at the moment understand. Suddenly the head was pushed outside the previous outline, and for an instant I saw a constriction behind it as though a tight cord was encircling the neck. The rotifer continued to press forward, the constriction, when I could see it, passed further back, and then the outline of the animal became normal as it extended itself. Behind it I saw a somewhat torn and shrivelled membranous sac, and the rotifer began wandering about the cell, occasionally feeding.

On the 24th it was again found in a retracted position. I saw it push out and withdraw the foot several times, but no other movement was observed.

On the 25th, before searching the cell, I added a modicum of fresh water to the contents. I found the rotifer again encased in a sac. After watching it for some time I saw it moving, at first gently and then more vigorously. After about 10 minutes the "membrane" was broken and the rotifer emerged, at once commencing to feed, but not continuing long.

On the 27th it was, for the third time, encased in a membranous sac. I watched it for some 90 minutes before putting fresh water into the cell. During this time I wrote up the notes now summarised, looking at the animal at short intervals, and seeing only occasional and moderate movements. I noticed that the "membrane" showed many transverse wrinkles, and I could distinguish the movement of one vibratile tag and of ciliary action in the intestine. I had delayed adding water that I might see whether the movements of the animal were stimulated by the illumination or not. When the water was added, the movements became at once more energetic. During the next hour water was added twice more, but, beyond inducing for a time more vigorous movements, there was no effect apparent. The "membrane" was not burst then or later.

On the 28th and 30th November the animal was still healthy in appearance, and on the latter date moved a little when water was added. On the 11th December it was still in the sac and alive. My last note, of the 2nd January, 1895, says only that the rotifer seemed to be dead a week before. It had lived for some five weeks from the date of its first encystment.

I had made no sketch of the encysted animal, and as I had not shown

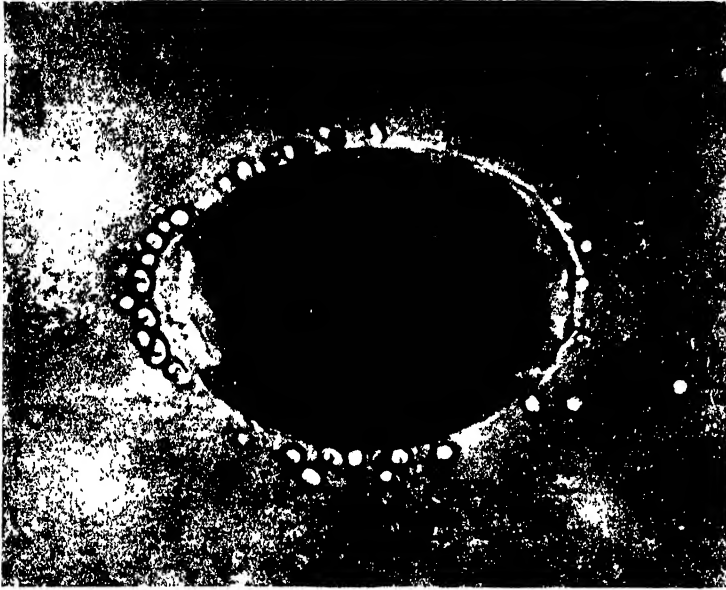


FIG. 2.—Encysted Bdelloid Rotifer (Third Case).
Macrotrochlea natans (Murray). $\times 660$.
Microphotograph by Mr. A. W. Dennis.

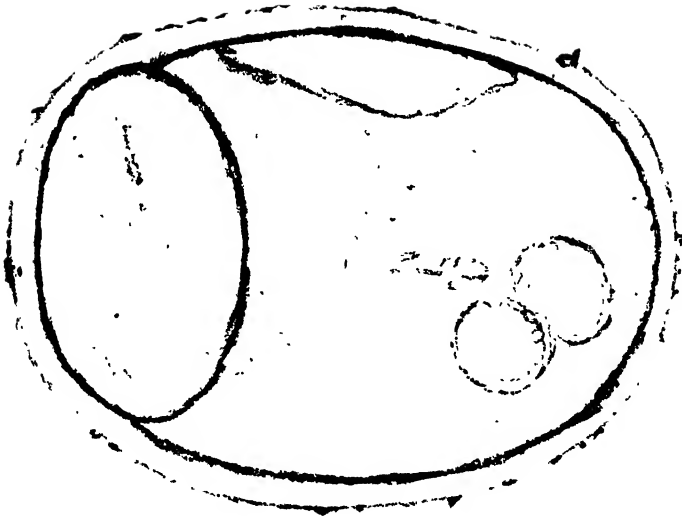


FIG. 1.—Encysted Bdelloid Rotifer (Second Case).
Sketch by M. de Koning. $\times 760$.

it to any other microscopist, I did not consider that the encystment observed should be recorded on the evidence of my meagre notes alone. Indeed, I rather hoped that I should soon find another example either of the same form or of some other undergoing encystment in a similar way.

After the lapse of 84 years a second instance has occurred in my own work ; but a little while before it came under my eyes I heard from M. de Koning that, in searching some moss which had been sent to him from the downs near The Hague, he had found five specimens of a Bdelloid which had only two toes, and that one of these specimens "enveloped itself with a slimy cover before it dropped its egg. After having dropped the egg, this latter stayed in the cover. Two times I saw this with the same specimen."

In my reply to his letter I acquainted him with my experience of 1894, which had not previously been communicated to him, nor, as I believe, to anyone else. He has now furnished me with a figure and the following data relating to his animal, which provides, in point of date, the second case of encystment and one quite independently observed :—

1928

- 21 March—A rotifer with a rather advanced egg in the body was set apart.
- 26 March—The shrivelled animal, together with egg, was enclosed in a slimy coat ; on the coat here and there some very small detritus particles.
- 27 March—Animal out of coat and crawling about. Egg remains in the coat still.
- 28 March—Egg unchanged. Animal shrivelled together (without coat).
- 30 March—Animal again in a cover. Another egg visible in animal.
- 31 March—First egg has already the beginning of a mastax. The second egg is laid, again in a slimy coat. The animal itself not found.
- 8 April—First egg is developed strongly. Second egg with mastax. (Progress no longer watched.)

As in the first case, the encysted rotifer was a moss-dwelling Bdelloid and had been set apart for further observation. It appears to have belonged to an undescribed species, as its salient peculiarity of two toes is a character only known as yet to be possessed by *Didymodactylos carnosus* Milne, a native of South Africa, and it is not identical with that. It will probably be described shortly by M. de Koning.

So far as the encystment and its general history are concerned, the third instance follows, like the second, very closely in the steps of the first. On the 2nd November last, while examining an ordinary net gathering from a local tributary of the River Mole, a Bdelloid rotifer was isolated and, after a cursory examination, recognised and then put away in the damp chamber in the usual course. On the fourth day it was seen to be in a retracted position and was thought to be sickly. Two days later it was found enclosed in a membranous sac. After thirteen days more the live-cell was taken to

the meeting of the Royal Microscopical Society, as stated above, and the animal exhibited there as an exceedingly rare rotifer which had become encysted. In the course of getting it into focus the sac was slightly damaged, but the rotifer did not emerge. On the following day, however, it was found swimming about vigorously in the live-cell. The empty sac was lost. Several days later the animal was again encased and was seen to be alive then, and several times more at intervals of a few days. On the 5th December, when nearly five weeks had elapsed since its capture, I took the specimen to Mr. Dennis to be photographed; but when returned to me that evening, the rotifer could not be found in the live-cell, and I failed to find it or the sac again. While getting it into position on his microscope and adjusting the focus, Mr. Dennis had seen the animal moving within the cyst.

In considering these cases of encystment, one is urged first of all to inquire whether they afford evidence that the capacity for self-encasement in this fashion is widespread among all rotifers, among Bdelloids only, or a property of isolated species of Bdelloida. I find no evidence so far that this capacity exists outside the Bdelloida, but I think that these cases afford strong grounds for the belief that it is widespread among them and not confined to isolated species. There are two main reasons for that view. The first is based on the wide difference in the life-histories of the three species of Bdelloids concerned. It is well known in these days that a large proportion, probably the great majority, of Bdelloid rotifers live a sort of double life, a life of alternate periods of activity and of dormant existence, according as their habitat happens for the time to be wet or dry. Such species mostly live in mosses growing in positions usually dry, and are known, therefore, as moss-dwelling Bdelloids. So long as the moss is wet, the animals are active. They increase and multiply and doubtless make merry. But when the moss begins to dry, they take alarm and quickly retract their extremities within the central portion of their bodies and so, reducing their bulk as much as possible, exude from the pores of their skin (according to Davis's explanation of the phenomenon) a natural secretion which completely covers them and hardens to an air-proof coating as the air reaches it. In this condition the rotifer can remain dormant for long periods. Under natural conditions the periods are probably comparatively short, but frequent in recurrence. When the habitat is again wetted by dewfall, rainfall, or otherwise, the water dissolves the coating and the animal renews its activities. Two of the encysted rotifers had been revived from such a dormant condition before they were set apart for closer examination. They were therefore capable of both capacities—of the ordinary resource against desiccation and of the resource by way of encasement against disagreeable environment. The third rotifer, an example of the three-toed *Macrotrachela natans* (Murray), on the contrary, was not only leading an active life itself when it was captured, but it belonged to a species which has always been found hitherto under similar conditions, and there is therefore no particular reason to believe that it is even able to employ the

ordinary coating as a defence against the dreaded desiccation. I am not at all satisfied that this latter capacity is universal among the water-dwelling Bdelloids.

The second reason is the difference in the foot-structure of the three species, which have respectively four, two, and three toes each. In the current classification of the order the number of toes is one of the more important details by which the various genera are distinguished. Although all three species are Bdelloids, they are shown by this detail to belong to genera not even closely related.

In the specimens seen by me the sac itself seemed tenuous and flimsy in texture. That it would afford any protection against desiccation is unknown, yet it might well be sufficiently effective as a protection from roving enemies. It seemed to fit the retracted and consequently somewhat oval and flattened form of the animal fairly closely, but now and again a space would be discernible between its inner surface and the skin of the rotifer. It was obviously in no way attached to the body, as the animal was repeatedly seen to turn itself about within it. Thus it is very different from the usually secreted coating, for in that the animal is apparently unable to move until the coating has been softened or dissolved, and whatever it may be that protects the rotifer is for the time part and parcel of itself.

Finally I would suggest that the reason that similar cases of encystment have not previously been detected is perhaps that very few observers have kept these animals alive from day to day in almost minute quantities of water. That the short supply of water was the reason for the encystment in all three cases can scarcely be doubted.

XVI.—TWO NEW SUCTORIA FROM SEWER WATER.

By EKENDRANATH GHOSH, M.Sc., M.D., F.Z.S., F.R.M.S.,
Professor of Biology, Medical College, Calcutta.

(Read April 17, 1929.)

TWO TEXT-FIGURES.

I.—*TOKOPHYA BENGALENSIS* sp. nov.

BODY more or less pyramidal, equalling the diameter of the base in height. A cup-like depression at the narrow fixed end. Two rounded bosses at the free end, supporting the tentacles, which are 10 to 12 in number in each. Tentacles sub-equal in length, and half the body or more in length. A spherical contractile vacuole close to one of the two bosses. An irregularly

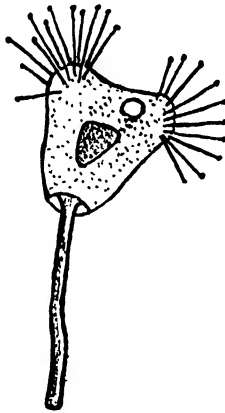


FIG. 1.—*Tokophrya bengalensis*.
× 236.

pyramidal macronucleus in the middle of the body. Micronucleus was not detected.

Pedicle cylindrical, slightly widened out at the junction with the body, and about one and one-half times as long as the body.

Length of the body 75 mm. Greatest width at the top 72 mm.

Several specimens were found in the sewer water at Calcutta. It resembles *T. cyclopum* Clap. and Lach. and *T. infusionis* Stein in having two bundles of tentacles on two bosses. It, however, differs from the first species in

having more tentacles from each boss, a pyramidal macronucleus and in several other characters, and from the second species in its long pedicle, pyramidal macronucleus and in a single contractile vacuole.

II.—*PODOPHYRA BENGALENSIS* sp. nov.

Body sub-spherical. Tentacles cylindrical, straight, unequal in length, placed radially, less than the body diameter in length and 17 in number, each with a small swelling at the free end. Cytoplasm finely granular. Macronucleus spherical, sub-central, slightly towards the upper surface of

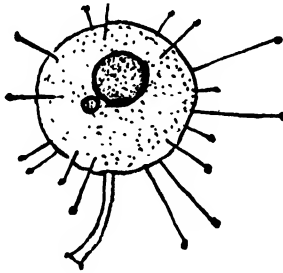


FIG. 2.—*Podophrya bengalensis*.
× 675.

the body. Micronucleus small, spherical, and placed at the side of the macronucleus. No contractile vacuole.

Pedicle cylindrical, slightly dilated at the free end, and nearly two-thirds the diameter of the body in length.

Diameter of the body 32 μ m. Length of the pedicle 22 μ m.

Several specimens were found in the sewer water at Calcutta. It differs from the five or six known species of *Podophrya* in the length of the pedicle, characters of the tentacles, and in the absence of the contractile vacuole.

XVII.—A METHOD OF FINDING THE REFRACTIVE INDEX OF A DROP OF MOUNTING MEDIUM.

By D. S. SPENCE, M.B.

(*Read April 17, 1929.*)

ONE TEXT-FIGURE.

THE amateur microscopist sometimes desires to find the refractive index of a substance which he has compounded for use as a mounting medium, and is at a loss how to do it. On reading the text-books of practical optics, he discovers that their methods suffer from the disadvantages of needing expensive apparatus, demanding more medium than he has available, or impossibility of application to the medium to be tested. However, that ingenious and versatile student of optics, Mr. E. M. Nelson, published in the *Journal of the Royal Microscopical Society* for 1894, p. 655, methods for determining refractive indices of fluids between 1 and 3, one of which methods, slightly modified in apparatus, technique, and calculation, as described below, is a simple and accurate way of finding the refractive indices of substances likely to be useful as mounting media.

Mr. Nelson originally placed a drop of the liquid to be tested between the parts of a lens system held in the substage of a microscope, and measured the distance from the drop to the image of a very distant object formed at the level of the stage. The lens system is one of a set of eight, each adapted for a range of $\cdot 25$ in refractive index, and when each is used with media in its own special range, the image of a very distant object lies roughly between 2 ins. and 4 ins. from the drop. Some of the systems are complicated to make and set up; but, fortunately, that for 1.75 to 2 is not only very simple and inexpensive, but can also be used for a range some distance below and a considerable distance above that for which Mr. Nelson designed it. For these reasons it is remarkably suitable for exploring the almost unknown and generally neglected region between Stephenson's medium (saturated watery solution of potassium and mercury iodide) and realgar, into which only a few pioneers, chief among whom were Prof. Hamilton L. Smith and Dr. W. Morris, have penetrated. As used by Mr. Nelson, the apparatus consisted of two microscopical slides, with plane parallel surfaces, made in glass of refractive index 1.5, in one of which was ground a spherical hollow whose radius of curvature was one inch. The hollow of the slide was filled with a drop of the medium, and the plain slide was pressed down on it, excluding air-bubbles. Then the slides were inserted in the substage of a microscope, the plain slide being above the other, and by the aid of a

sensibly plane mirror the image of a very distant object was focused on the lower surface of a slide in the usual position on the stage. Mr. Nelson stated that the refractive index of the medium was equal to $1.5 + 1/F$, where F is the distance in inches between the image and the drop.

Mr. Nelson evidently treated the problem by the formulæ appropriate to thin lenses. On applying the more rigorous processes of geometrical optics, it will be found that a considerable simplification results from turning the system upside down, so that the plain slide faces the very distant object. Since a medium bounded by plane parallel surfaces does not refract rays perpendicular to its surfaces, a piece of any kind of glass of any convenient thickness may be used for the plain slide, if its surfaces are plane and parallel. The nearer the refractive index of the medium is to that of the hollow slide, the greater the distance of the focus from the drop. For this reason, if refractive indices much below 1.75 are often measured, it will be found useful to have another slide with a spherical hollow whose radius of curvature is less than one inch. Vitreous silica, whose refractive index is 1.4585, used for the hollow slide, gives not only the advantage of a lower range of indices,

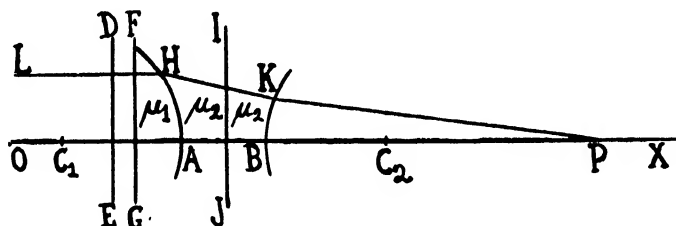


FIG. 1.

but also that of greater suitability for use with media which need to be melted. For media between 2.25 and 2.5 Mr. Nelson used a slide with two hollows, one in each surface; but if the second slide mentioned above is available, it may be placed on the other hollow slide with the plane surfaces in contact and the hollows centred, so as to increase the focal distance. If this is done, the two slides must have the same refractive index, otherwise the mathematical formula becomes much more intricate.

Before describing the experimental procedure in detail, it is necessary to discuss the geometrical optics of the apparatus. The diagram illustrates the general case where two hollow slides are used. OX is the optical axis, and DE and FG perpendicular to it are the surfaces of the plain slide. The surface of the lower hollow is represented by the arc AH , whose centre is at C_1 , the surfaces of the two hollow slides in contact by IJ , and the surface of the upper hollow by the arc BK , whose centre is at C_2 . The space between FG and AH is filled with the medium to be examined. Using the ordinary Cartesian conventions, in which all distances are measured from O , and are called positive when to the right of O , let the distances from O of A , B , C_1 , and C_2 respectively be a , b , c_1 , and c_2 . Let a ray from a very distant object

on the axis to the left of O traverse the system. It will continue parallel to OX, as represented by the line LH cutting the surfaces DE and FG, until it meets the curved surface AH, when it will be refracted, as represented by the line HK, crossing the surfaces IJ without being refracted, and will meet the surface of the upper hollow at the point K. There it will be refracted again, and will cut OX at the point P, at a distance p from O. Calling the refractive index of the medium μ_1 , and that of the hollow slides μ_2 , the following relation is found by elementary optics to subsist between μ_1 , μ_2 , and the distances a , b , c_1 , c_2 , and p :—

$$\frac{\mu_1}{\mu_2} = \frac{bc_1 - pb + \mu_2 pc_2 - \mu_2 bc_2 - \mu_2 pc_1 + \mu_2 bc_1 + pc_1 - c_1 c_2}{bc_2 - pb + \mu_2 pc_2 - \mu_2 bc_2 - \mu_2 pa + \mu_2 ab + pa - ac_2} \quad (1)$$

For experimental purposes it is more convenient to make all measurements from an easily identifiable point on the apparatus, instead of from a hypothetical point below it, and the best point for the purpose is probably the centre of the surface, or, in other words, the deepest point of the upper hollow. If this, the point B, is made the origin, the equation (1) becomes

$$\frac{\mu_1}{\mu_2} = \frac{\mu_2 pc_2 - \mu_2 pc_1 + pc_1 - c_1 c_2}{\mu_2 pc_2 - \mu_2 pa + pa - ac_2} \quad (2)$$

where a , c_1 , c_2 , p , are now the distances of A, C_1 , C_2 , P, respectively, from B. When only one hollow slide is used, the upper surface is plane, and C_2 is at infinity, so that equation (2) becomes—

$$\frac{\mu_1}{\mu_2} = \frac{\mu_2 p - c_1}{\mu_2 p - a} \quad (3)$$

For putting the method into practice it is necessary to have some means of reading the position of the tube of the microscope. A vernier calipers to measure the distance between a point on the tube and a point on the stand is a suitable way, in default of a scale engraved on the microscope, which only a few microscopists possess. With the apparatus in position on the stage or substage, the upper plane surface of the hollow slide, or the centre of the surface of the upper hollow slide, if the two slides are used, is focused as in an ordinary observation with the microscope, and the position of the tube read off. The tube is racked up until the image of a very distant object comes into focus, and the position is read again. The difference between the two readings is p in the equations above. In substituting numbers for a and c_1 , it must be borne in mind that these are to the negative side of B. The thickness of the slide or the combined thickness of both at the deepest point of the hollow (best measured with a screw micrometer) is minus a , and the sum of this thickness and the radius of curvature of the hollow in the lower slide is minus c ; so that in the numerical calculations the terms of the numerator and denominator of (2) are in order $+$, $+$, $-$, $+$, and those of (3) are all positive.

For instance, if the difference between the readings be 50 mm., the radius of curvature of the lower hollow 25 mm., that of the upper 15 mm., the combined thickness of the slides at the centres of the hollow surfaces 2 mm., and their refractive index 1.5, equation (2) becomes

$$\frac{\mu_1}{1.5} = \frac{1.5 \times 50 \times 15 + 1.5 \times 50 \times 27 - 50 \times 27 + 15 \times 27}{1.5 \times 50 \times 15 + 1.5 \times 50 \times 2 - 50 \times 2 + 2 \times 15} = \frac{2205}{1205}$$

so that the refractive index of the medium is 2.74.

Again, if when using only one slide of refractive index 1.5, whose thickness at the centre of the hollow surface is 1 mm., and the radius of whose hollow is 25 mm., the difference of readings were found to be 75 mm., equation (3) would become

$$\frac{\mu_1}{1.5} = \frac{1.5 \times 75 + 26}{1.5 \times 75 + 1} = \frac{138.5}{119.5}$$

so that the refractive index of the medium is 1.83.

If many media were to be tested, it would save trouble to draw a graph for each arrangement of the apparatus, plotting focal distance against refractive index from the equations, and interpolating the difference of two readings.

To show the accuracy of which the method is susceptible, it may be added that, for a difference of 1 in the second decimal place of the refractive index of the medium, using the single slide as above, the difference in p is 1 mm. when the refractive index is nearly 2, 2 mm. when the refractive index is nearly 1.83, and 4 mm. when the refractive index is nearly 1.75.

Since the above was read at the meeting of the Society, I have found that a method involving the focal length, instead of the position of the focal plane, as suggested to me by Mr. Conrad Beck, is very simple. The numerical value of the focal length of the system with only one hollow in the upper slide is the radius of curvature of the hollow divided by the difference between the indices of refraction of the medium and that of the hollow slide. The focal length may be measured by Prof. F. J. Cheshire's method (J.R.M.S., 1914, p. 513), or by finding the length between the images of two very distant points, one of which is on the optical axis, and which subtend a convenient known angle at the point of observation, and dividing the length thus found by the tangent of the angle. Where s is the length, θ this angle, and r the radius of curvature of the hollow slide, the refractive index of the medium is equal to $\mu_2 + \frac{r \tan \theta}{s}$.

This method is not open to the objections, based on suggested uncertainties of focus, that have been urged against the former, and the system can be placed with the plane slide away from the distant points, so as to diminish spherical aberration.

XVIII.—NOTES ON THE ABBE THEORY.

By SIR HERBERT JACKSON, K.B.E., F.R.S.

(Read March 20, 1929.)

ABOUT the year 1883, and at a time when I was more or less regularly teaching certain students the use of the microscope, the Abbe theory of microscopic vision had just been introduced and was much discussed. In carrying out the well-known experiments with a grating as the object on the stage, I was unable to understand the relevancy of the effects obtained to the actual use of the microscope, or to see how these effects differed from those which could be obtained with a transparent diffraction grating in a spectroscope, an instrument the use of which, in chemical work, I was also dealing with at that time. I was in the habit of describing and showing the following simple experiments :—

If we take a luminous source such as a candle flame and examine it through a coarse grating of about 3,000 lines to the inch, multiple images of the candle flame are seen, the central image being normal and the side images fringed with colour. If, however, a hand lens $\times 20$ is placed between the eye and the grating, a focused image of the diffraction grating is obtained. We have here to consider that in the first place the eye forms an image of the candle flame, which image is modified by the diffraction grating which has been placed in the path of the light ; in the second case, however, it is immaterial what source is being used to illuminate the grating. The hand lens is taking light which must be treated as originating at the grating itself and is rendering that light parallel, so that the eye receiving this parallel light forms an image of the grating.

This example shows that if we are obtaining an image of any particular object, we must consider the light as originating at that object, i.e. the object whose image we are producing must be treated as a self-luminous object whether it be self-luminous or not.

If the conditions of illumination of the object are such as to restrict, in some special way, the rays coming from the object, we may get diffraction effects resulting from this restriction, but these effects will not be such as would improve the resolution of the object ; they would be such as might entirely prevent the object from being recognised from its image, and in any case would mar the sharpness of definition of the image seen.

To show this effect I used to take any lined object brightly illuminated,

e.g. white lines on a black ground, and let students examine them through an adjustable slit placed in front of the eye, the length of the slit being placed parallel to the lines. On gradually closing up the slit the lines were seen to widen and become more nebulous in outline and finally blurred into one dull grey band of light extending for some considerable distance in a direction perpendicular to the length of the slit. Later on, when the ordinary incandescent electric lamp was available, I employed that as the object, and the appearance was more striking. The deduction drawn was that for the production of satisfactory images, diffraction or interference effects were to be avoided rather than sought, and that, although under certain conditions interference fringes in the microscope might give rise to a semblance of an image, the appearance could not be truly regarded as an image at all. I could not see how there was any difficulty in recognising that if any particular explanation were given of the effect of aperture in a telescope or a photographic lens, the same explanation would apply equally to a microscope lens, and I was, therefore, in the habit of teaching my students that the principles of the microscope were the same as the principles of any other optical instrument in which lenses were used, and that, in order to obtain the most truly representative image, an object-glass having the largest aperture convenient should be used and that the illumination should be a cone of wide angle.

Throughout my earlier teaching I was in the habit of laying great stress on the value of dark-ground illumination, and of showing to my students the benefit of the increased contrast obtainable by this form of illumination and the more readily recognisable resolution resulting from this enhanced contrast. When, therefore, the deduction was made from the Abbe theory that dark-ground illumination could never give resolution equal to that which could be obtained with the same object-glass used with transmitted light, I had merely to think back about what I had done and what I had been in the habit of showing—for example, convincing resolution of *Pleurosigma angulatum*, using a lens of 0.7 N.A. with a dry front paraboloid condenser or with a high-angle dry achromatic condenser with a central dark stop and an aperture transmitting a hollow cone ranging from 0.8 to nearly 1.0. Also with an immersion condenser, using a black stop in it, and a dry front object-glass having a N.A. of 0.95, I have frequently examined and shown the resolution of *Surirella gemma*. According to the legitimate deductions from the Abbe theory, my condenser in the first instance ought to have had a numerical aperture of at least 1.35, taking the spacing of the dots in the *angulatum* as $1/45000$ inch. In the second instance, taking the spacing of the lines in *Surirella gemma* as $1/65000$ inch, and the spacing of the dots in the lines as $1/80000$ inch, the immersion condenser required to show the lines should, according to the Abbe theory, have a N.A. of 1.95, and for the resolution of the lines into dots the N.A. would have to be 2.4. I am speaking of using green light of wave-length $1/50000$ inch. With blue light the requisite aperture would be about four-fifths of the above values.

The fact that, whenever possible, I was in the habit of examining every object with dark-ground illumination as well as by other methods of illumination, and that I had never noticed anything but slightly enhanced resolution with the dark-ground, left me in a position that the deductions to be drawn from the Abbe theory were inconsistent with my own experience, and I left it at that. I was forced, therefore, to ignore Abbe's theory both in respect of my own use of the microscope and in any teaching I had to give.

I might add that I discussed the whole matter on several occasions with various physicists. Those to whom I showed the diffraction experiments were much interested in what is undoubtedly a very fascinating demonstration of diffraction and interference effects as obtainable with microscopic objects, but they could not see how those effects could be in any way considered as image formation.

When I told Dr. Moore, nearly ten years ago, of my difficulty of understanding why the Abbe theory had apparently become so well established among microscopists, and when I showed him the diffraction experiments and resolution under dark-ground illumination, he decided to go much more closely into the whole matter, from the physicists' point of view, as time permitted. He was entirely unable to see how diffraction effects would remain visible as the cone of illumination was increased, and consequently, since images were formed with wide cones of illumination, he could not consider that in the microscope, as ordinarily used, the image formation had anything to do with the interference effects which are obtained with extremely narrow cones of illumination. With more urgent work claiming his attention, Dr. Moore could not take an opportunity of going into the subject more in detail, but had satisfied himself that diffraction could not play the part attributed to it on the Abbe theory in producing images in the ordinary use of the microscope. Recently Mr. Conrad Beck drew Dr. Moore's attention to Prof. Berek's paper. Mr. Beck's great interest in all questions affecting the theory and practice of microscopy, and his own experience of the value of dark-ground illumination in obtaining convincing resolution of many objects, prompted him to ask Dr. Moore to give a short abstract of Berek's paper, together with a brief account of the work which Dr. Moore himself had done.

I should like to conclude by saying that whatever criticism we may make of the Abbe theory, that must not dim our recognition of the great work Abbe did in optics, nor can it mar our appreciation of the valuable services he thereby rendered to science.

XIX.—ON THE QUALITY OF THE IMAGE AND RESOLVING POWER IN THE MICROSCOPE.

By Professor HENRY F. W. SIEDENTOPF.

(Read March 20, 1929.)

ONE TEXT-FIGURE.

THE quality of the microscopic image and the resolving power of the microscope are not, as is well known, mutually interchangeable terms. An illustration of this is furnished by the uncorrected front lens, with the aid of which a high resolving power may be attainable by the use of oblique light, while yet in other respects the image formed is defective. Even when using such an uncorrected lens it is practicable to bring about the formation of a good image by so selecting the image-forming grating and the obliquity of the illumination that the first maximum of diffraction and the illuminating pencils may fall upon an identical zone of the objective. The explanation is that in these circumstances the other uncorrected zones of the objective do not participate in the formation of the image.

Another illustration of the non-identity of the two principles is afforded by the high value of the resolving power which we obtain when illuminating with unusually narrow pencils of so small an aperture as about 10^{-4} and using by way of an object the so-called ideal double slit made up of two fine lines on a dark ground, the width of either line being small in comparison with the gap separating them. When the obliquity u of the illumination and the gap Δ between the lines conforms to the equation

$$\sin u = \pm \frac{(2h+1)\lambda}{2\Delta}, \text{ for } h = 0, 1, 2 \dots \quad (1)$$

Abbe's theory of the formation of images in the microscope furnishes the following relation for the intensity of the image, if we omit a negligible constant

$$I_{\text{coh}} = \left(\frac{\sin w_1}{w_1} - \frac{\sin w_2}{w_2} \right)^2 \quad (2)$$

This equation shows that the intensity vanishes whenever $w_2 = -w_1$, that is to say, when we view the centre of the image, while at the same time it is immaterial how small we choose to make the gap between the two lines.

Incidentally it may be noted that this obvious conclusion did not suggest itself in the reading of Abbe of 1887, as edited by Lummer and Reiche. On the other hand, independently of Abbe's reading, which then had not yet been published, Lord Rayleigh had already recognised this theoretical conclusion and also supported it by an experimental demonstration.

In this second illustration the quality of the image suffers in an extraordinary degree despite the high value of the resolving power, though in this case the causes of the deformation of the image belong to the domain of physical optics and not, as in the first case, to that of geometrical optics.

In applying the term "resolution" to the image of the double-slit image

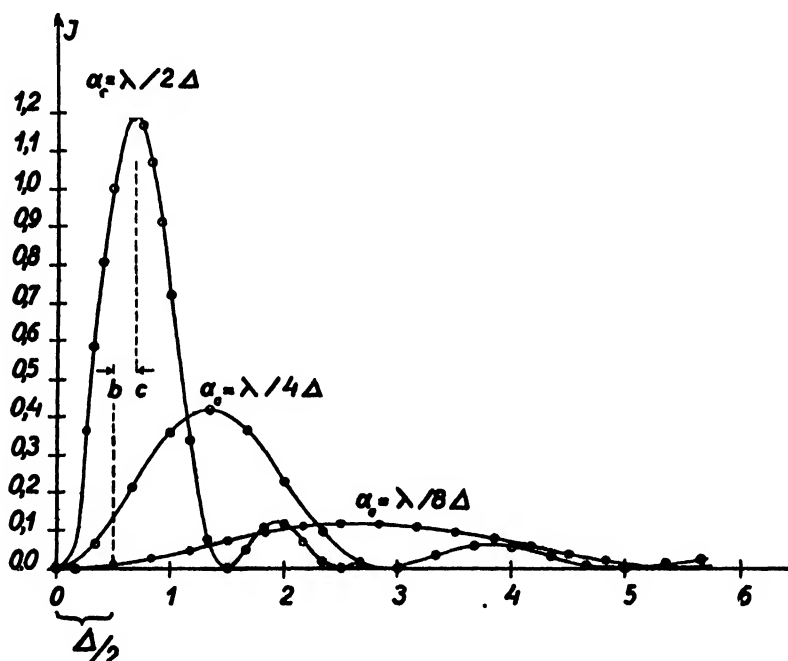


FIG. 1.

when the intensity vanishes in the middle, it must be clearly understood that other characteristic features of this object may give rise to very faulty appearances in the resulting image. This may be readily realised by computing in accordance with equation (2) the distribution of the intensity for

$$\Delta = \lambda/2a, \lambda/4a, \lambda/8a \quad (a = \text{aperture of the objective}),$$

which may be done with the assistance of a convenient table prepared by Bouasse, and plotting the values of the distribution so found as shown in fig. 1. Incidentally it follows that the condition of higher resolution vanishes if the number of lines or their width be increased, or if the aperture

of the illuminating pencils be widened. In actual practice, even using sunlight,

$$\Delta = \lambda/16a \ (\sin u = 8a)$$

is probably the smallest value which may be given to the gap between the lines owing to the rapid decrease in the intensity of the phenomenon.

Particular interest attaches to the distance bc of the maxima of intensity c from the location b of the elements of the double slit (fig. 1). Expressing this distance in terms of the slit-gap, we obtain an approximate measure of the degree of deformation by which in these pseudo-images the two lines of the double slit differ in their mutual distance from the true gap between them. Naturally the deformation in the image distance of the elements of the double slit diminishes in amount in a measure as this distance increases relatively to λ/a . The deformation cannot, however, disappear until λ/a reduces to zero.

Objects of the nature of double slits or gratings are exceptional in their practical occurrence in microscopic observations. Ordinarily microscopic objects have irregular contours and, more especially, a *thickness* which bears a certain relation to the wave-length of the light. Respecting this aspect we lack theoretical foundations such as should be available for experimental verification in the microscope. The author has elsewhere called attention to the complicated processes of diffraction which must surely take place when images are formed of such objects as red blood-corpuscles, and it is obvious that in the present state of our knowledge any attempt to approach such problems on a theoretical basis is out of the question. It is therefore at the present stage far more promising to proceed along purely experimental lines and to test by accurate measurement the microscopic images which result under appropriately varied conditions and which may furnish enriched conceptions of the potentialities of the formation of microscopic images.

The successful application of microscopic measurements imperatively implies a knowledge of the modern theory of contrasts. It would seem, indeed, that the microscopic image furnishes a wider field for the application of the theory of contrasts than the observation of self-luminous bodies in astronomical images. In accordance with the theory of contrasts, it behoves us to distinguish between the boundaries of the *seen* image and the *true* boundaries of the object. The variation of the intensity at each of the contour lines of the image is never discontinuous, but invariably proceeds by values which can be plotted along a curve. The eye is able to seize upon a certain point as representing a limiting value. In simple cases it may be practicable to compute the theoretical form of this curve. When the object is very thin in relation to the wave-length of the light, being, let us say, of the nature of a transmissive slit of finite width on a dark ground, we obtain in the case of non-self-luminous bodies an intensity curve which in the general case of oblique illumination may be expressed as an aggregate of functions representing an integral sine function, which may be calculated with the aid of

tables. Forming the second differential quotient of this curve, we obtain a new curve, which in the theory of contrasts is described as a "contrast function." The cases which are particularly significant are those where this contrast function vanishes or where it has a maximum or a minimum in that the eye is then able to fix upon a limit.

It may now be assumed that the image of best quality has corresponding to it that intensity curve in which the limit, as seen by the eye, deviates least from the true limit. In this case experiment shows that one and the same object may furnish any number of different intensity curves, since its form is governed by very many factors: Respecting the relations of these factors and the form of the curves microscopic measurements may furnish a mass of information.

The corrective relation between limits as seen and true limits is dependent, in the first place, upon λ/a . We may suppose this function expanded into a series, and since these corrections involve small values, all but the first term of the series may be neglected. The error then becomes proportional to λ/a . Incidentally, it is interesting to note that the image deformation is proportional to the reciprocal of the aperture. It would seem, therefore, useful to introduce a term for this latter value, and as such I would suggest the word "closure." Plotting, then, the closures as abscissæ, we obtain for the deformation a straight line, the course of which is easy to follow, whereas a hyberbolic curve results if we plot the aperture values themselves as the independent variables.

A further influence, which in certain circumstances may be even more pronounced than that just referred to, is exercised by the state of centration of the illumination. This influence may become manifest in different degrees according as the obliquity of the illumination due to decentration is parallel or at right angles to the object, which, for the sake of argument, we will suppose to be of the nature of a slit. Similarly, there is a third factor, the width of the illumination, which affects the measurement in a marked degree. It is this influence, in particular, to which the author would draw the attention of the reader within the limits of this short article. The influence may show itself in different ways, according as a bright image of the object is formed on a dark ground or vice versa. Incidentally, it may be noted that this likewise applies to the majority of the factors which affect the quality of the image. Also the shape of the effective aperture of the objective and of the condenser affects the measurements, which vary, for example, according as its contours present a circular, a slit-like, or some other configuration. A further source of variation is the orientation of this aperture with respect to the axis of the microscope. Also the state of correction of the objective and condenser requires to be fully taken into consideration. In the case of non-self-luminous bodies, moreover, if they happen to transmit light, it is necessary to take into account the retardation in the preparation, and in the case of self-luminous bodies the same should be done with the law of radiation. The most important influence, however, is exercised by the exactness with

which the image is focused. The whole of these influences, again, may become subject to variation according to the shape and size of the object.

In view of all these different conditions, it is obvious that the exercise of a very considerable degree of skill is demanded on the part of the microscopist who undertakes these measurements, and it may even be questioned whether he is likely to succeed in mastering them in their entirety. At all events, it is well known that many of the microscopic measurements dealt with in the available literature require to be approached with caution. But even where nothing more than the value of approximate estimates is claimed for them—for example, in reference to the thickness of the flagellæ of bacteria—we may well distrust the accuracy of the very order of magnitude, seeing that the thickness of the flagellæ of *B. pyocyaneus*, *S. volutans* and *Proteus* has been stated to be 0.025μ .

Now, keeping λ/a constant, let the aperture of the objective be circular; further, let the illumination and microscope, as well as both with respect to one another, be as exactly centred as may be practically attainable; let the objective be an apochromatic $60\times$ of num. apert. 0.95 having its correction mount carefully adjusted to satisfy the criterion afforded by the dark field; let the source of light be a centring tungsten arc lamp in otherwise rigid connection with the microscope; let the condenser be an achromatic condenser of num. apert. 1.0 in an accurately focused position, and let the width of the central illumination be the only variable element. A variety of objects may be selected, such as a slit in a thin coating of silver, a thin filament of silver on a bright ground, small droplets of mercury, and small droplets of grease in water. We may proceed to measure the width or diameter of the objects with the aid of the eyepiece screw micrometer in conjunction with the compensating eyepiece $15\times$ or $20\times$ or with the aid of a stage screw micrometer. The measurements were made in such a way that for each setting of the objective there were only two measurements, but many repeated settings and their corresponding measurements were made in succession. By way of an example, it may be interesting to give the mean values of the measurements which in the case of mercury globules have resulted at different openings of the diaphragm in its carrier. These values are shown in the subjoined table, which, for the sake of completion, comprises data obtained with other objectives.

MEASUREMENT OF A MERCURY GLOBULE.

Objective.	Diameter of Iris Diaphragm under Condenser.				
	2 mm.	4 mm.	8 mm.	12 mm.	16 mm.
$60\times$; 0.95 N.A. . .	17.2μ	17.1μ	16.8μ	16.6μ	16.4μ
$20\times$; 0.68 N.A. . .	17.1	16.9	16.7	16.4	—
$10\times$; 0.32 N.A. . .	16.9	16.8	—	—	—

The table shows that in this case the variation of the width of the illuminating pencil has a more pronounced influence upon the quality of the image than the variation in the aperture of the objective. It will be seen that in the case of mercury globules the diameters as seen increase with the aperture of the objective, approximating to the true value; for, since the error diminishes as the aperture increases by reason of its proportionality to λ/a , we are justified in accepting the readings obtained at higher apertures as representing the more correct values. Then follows, so far as the measurement of microscopical small mercury droplets is concerned, the important conclusion that an increase in the width of the illuminating pencil has the effect of markedly augmenting the deformation of the image, which serves to confirm the rule set up by Abbe, according to which observation should be made with the narrowest illuminating pencils which can be used in practice.

When opening the iris diaphragm under the condenser, the narrow direct illumination has oblique pencils associated with it. While these are qualified to enhance the resolving power, they do not fail to increase the deformation of the image of a mercury globule.

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XX.—NOTE ON RESOLUTION WITH DARK-FIELD ILLUMINATION.

By A. S. BURGESS, M.A., M.D., F.R.M.S.

(Read March 20, 1929.)

TWO TEXT-FIGURES.

OPPONENTS of the Abbe theory have stated that :—

I. According to the theory, when dark-field illumination is used, the N.A. of the illuminating rays must be double that of the objective in order to obtain resolution equal to that obtained with oblique direct illumination.

II. Experiment has shown that this is not the case, the resolution

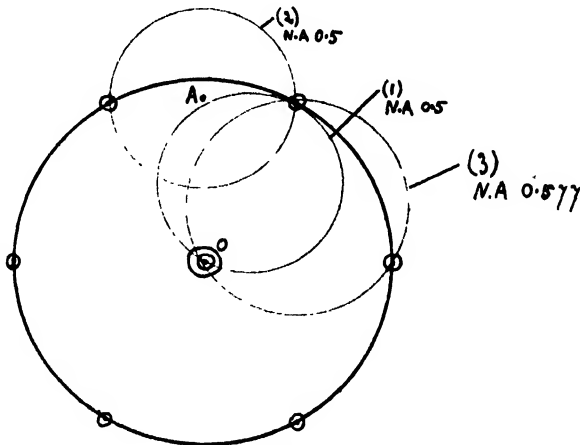


FIG 1.

obtained with dark-field illumination being at least equal to that obtained with bright-field illumination in all cases.

I think that both of the statements require modification, according to the type of object used. I have used two types of object, viz., the parallel grating, such as a Rowland replica, and the diatom *P. angulatum*.

Using a parallel grating and a very narrow illuminating cone, I found that if the lines were just resolved with direct illumination, they disappeared

on transition to dark-field illumination, but reappeared when the illumination became more oblique. These results were obtained with a Rowland replica, using ordinary annular dark-field illumination, and with the parallel grating of the Abbe diffraction plate, using illumination in one azimuth. In the latter case the illuminating rays were rendered gradually more oblique, and the lines appeared and disappeared four or five times before the illumination became too faint for observation.

The results of experiments with simple parallel gratings, therefore, are in accord with the theory, and not with statement II.

When *P. angulatum* was used as the object, the results were different, good resolution being obtained with annular dark-field illumination, although

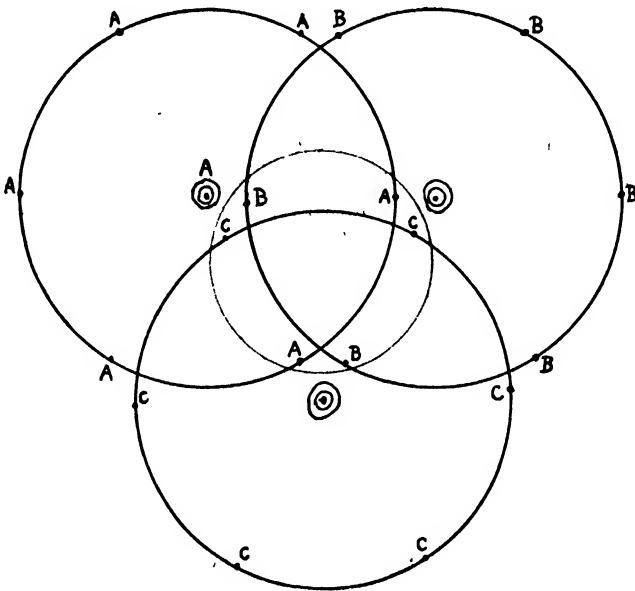


FIG 2.

the N.A. of the illumination was only slightly greater than that of the objective. This experiment agrees with statement II. When the illumination was in one azimuth and its obliquity gradually increased, the diatom was resolved into parallel lines. On passing from bright field to dark field, resolution was not lost, but the direction of the lines was altered, the dark-field ones being inclined to the bright-field ones at an angle of 60° . It was sometimes necessary to adjust the illumination in azimuth in order to obtain resolution. These results may be explained by reference to Fig. 1. In this the black figure represents the diffraction pattern given by *P. angulatum* as seen at the back of an objective. The red circles indicate objective apertures. By varying the obliquity of illumination the black figure would be shifted, but it comes to the same thing, and simplifies the diagram, to

regard the objective aperture as being shifted. Assuming the black circle to represent an aperture of 1 N.A., bright-field resolution is obtained with an objective aperture of 0.5 N.A., as shown by circle (1), Fig. 1. In this case the diatom is resolved into parallel lines inclined at an angle of 60° to the vertical. To obtain dark-field resolution the objective aperture is shifted to circle (2), and the lines are now vertical. The N.A. of the illuminating ray is represented by the distance AO. It is not double that of the objective, in which case it would be 1 N.A., but its value, obtained by calculation, is 0.866 N.A. Now, if the objective aperture is slightly greater than the bare minimum necessary for bright-field resolution, the N.A. of the illuminating ray necessary for dark-field resolution is much reduced. For example, circle (3) represents an objective of N.A. of 0.577 (0.5 being the bare minimum), and this intersects the direct beam and two diffraction spectra, and is therefore at the place of transition between dark-field and bright-field illumination. A slight shift inwards (with readjustment of azimuth) will give bright-field and a slight shift outwards dark-field resolution.

With illumination in one azimuth, only two spectra are taken up by the objective, and the diatom is resolved into a single set of parallel lines. If illumination is in three azimuths, symmetrically arranged, three pairs of spectra are taken up (see Fig. 2), and the diatom is resolved into three sets of parallel lines, the sets being inclined to one another, and the result is something very near full resolution. Conditions are similar in ordinary dark-field illumination, which consists of illumination in every azimuth.

To obtain resolution the objective aperture must be slightly greater than the theoretical minimum, and for satisfactory dark-field illumination there must be an interval between the N.A. of the objective and that of the illuminator, and these together are quite sufficient to obscure the small theoretical margin within which dark-field resolution should fail.

It appears, therefore, that results obtained by dark-field illumination of the objects mentioned do not furnish objections to the Abbe theory.

XXI.—ON THE EXTENT TO WHICH REAL IMAGE FORMATION CAN BE OBTAINED IN THE MICROSCOPE.

By M. BEREK, Wetzlar.

(Read March 20, 1929.)

FROM the time when the microscope was first discovered, up to the present, the practical biologist has never considered what he sees in the microscope except as a representation, in connection with which he assumes that any image detail selected out of the whole image owes its existence to some corresponding detail in the object, so that between the image and the object there is a precise correspondence in the sense of an association detail by detail. The development of the wave theory of light has shown, it is true, that this association cannot be pushed to an unlimited extent; but provided the limit which we call the limit of resolution is not passed, this immediate or detailed association is so familiar to (universally accepted by) practical microscopists that it becomes necessary to insist upon the fact that there are other views or considerations which should be taken into account.

These other considerations have been developed by Abbe in his theory. According to this theory, what is seen in the microscope is a secondary interference phenomenon, and the intensity observable at any point in this interference effect must always be understood as resulting from the combined action of the *whole* of the object-structure. Consequently, the view that there is an individual detail association of the elements in the image and the object cannot be applied to such an interference phenomenon, and, as an immediate further consequence, the Abbe theory does not deal with the limiting conditions which allow of direct association between elements in the image and object, but only with the conditions under which the secondary interference phenomenon can be in any way *similar* to the structure of the object. These "conditions of similarity" (*Ähnlichkeitsbedingungen*), as Abbe himself called them, are expressed in the well-known formulæ of the Abbe theory, viz. :—

$$l = \frac{\lambda}{A_0} \text{ for central transmitted illumination,}$$

$$l = \frac{\lambda}{2A_0} \text{ for extreme oblique transmitted illumination,}$$

$$\text{and} \quad l = \frac{2\lambda}{A_0 + \bar{A}_0} \text{ for dark-ground illumination.}$$

[Note by translator.— A_0 and \bar{A}_0 represent the numerical apertures of the object-glass and condenser respectively. These formulæ give the conditions

under which the lowest degree of similarity between the interference effect and the object is obtainable. In other words, provided the separation of the details in the object corresponds with the value of l , it will be possible to produce an interference pattern which bears some resemblance to the object. If the spacing interval is less than that corresponding to l , no resemblance whatever can be obtained (because no visible interference pattern will be produced). If the spacing interval is sufficiently greater than l , a higher degree of resemblance can be obtained, there being, according to the Abbe theory, different degrees of similarity between the interference pattern and the object, according to the number of diffraction spectra taken in by the object-glass.]

If it be conceded that the value of a theory can be estimated from what is deduced from the theory, then it must be admitted that a number of the deductions made by Abbe from his theory stand in direct opposition to what is known, on the grounds of practical experience, to be right. As an example we will quote simply the instructions for obtaining the best type of illumination. The Abbe theory states that to obtain the most definite type of image possible (or the best definition in the image) the iris diaphragm of the illuminating apparatus must be closed down until it is as small as possible, since the use of a wide cone of rays would only result in a confusing of the image and in reducing its similarity to the object, because with such a cone of rays separate images having different degrees of similarity to the object are superposed one upon another. The practical microscopist, on the other hand, knows that the images of the best quality can be obtained only by the use of a *wide* cone of illumination, assuming the object-glass to be perfectly corrected. In your country especially this fact has received widespread recognition, and in my own it was advanced more than forty years ago, in opposition to Abbe, by the well-known bacteriologist R. Koch, on the grounds of his practical experience. It is familiar to every experienced microscopist that reduction of aperture is only called for when the optical system is not satisfactorily corrected, or else when it is rendered necessary in order to make visible such structural details as are only slightly different in refractive index, or in their absorption effects, from the surrounding material. In proportion, however, as the condenser aperture is reduced, the quality of the image of any detail which could previously be seen is impaired, it being again assumed that a well-corrected object-glass is being used. It is seen, therefore, that in this matter the deductions drawn by Abbe from his theory are not in harmony with the results of practical experience.

On the part of the practical microscopist, however, the following statement of the case should carry greater weight :—If there is any warrant or justification for the way in which the practical microscopist works, in the sense that he can hope to draw any profit from what he sees in the microscope and to use this for the purposes of his investigations, this can only be if he knows exactly in what way he can correlate details of what he sees with

what is actually in the object-structure. This sounds very elementary, but Abbe's theory says it cannot be so.

The present state of development of the Abbe theory is not sufficiently far advanced to explain in any definite way how what is seen in the microscope is to be translated in order that it may be made use of for the purposes of an investigation; for in the "conditions of similarity" of Abbe's theory there is no statement of any kind which defines (or describes precisely) how we are to translate what is seen under the conditions which give the minimum degree of similarity. Only for the special case of gratings do we know that the secondary interference phenomenon shows exactly the same number of alternate bright and dark lines as there are rulings in the grating. Biological structures are very rarely gratings. What is the meaning of the appearance which gives the lowest degree of similarity to the object, when we are dealing with any type of structure other than gratings? An example may serve to illustrate this point. The well-known *Pleurosigma angulatum* is a calcareous (this should be "siliceous") scale or valve in which the foramina are situated at regular intervals, namely, at the angles of a network of equilateral triangles. If one produces an image under conditions corresponding to the minimum degree of resemblance to the object, by using oblique transmitted light with an object-glass of N.A. 0.5, then, as is well known, a system of lines is seen. The true structure, however, consists of a flake or scale with minute foramina, and it is obvious that the lined-grating appearance which is obtained in the phenomenon bears no resemblance whatever to the real form of the structure; it simply happens to be produced because the configuration of the foramina in the valve sends, under these conditions of illumination, two different maxima into the object-glass. Two coherent diffraction maxima, however, *always* produce an interference effect having the form of equally-spaced parallel lines, irrespective of the structure which gives rise to these maxima. The real meaning of the Abbe formula which defines the conditions giving the lowest degree of similarity to the object is, therefore, as follows: If the object, when illuminated under the conditions corresponding to formula (1), sends, in consequence of its structure, two diffraction maxima into the object-glass, a lined-grating appearance will *always* be produced. What exact relation this appearance has to the actual structure of the object cannot, however, be determined in any way whatever unless we already know what the structure is really like. It is obvious that the biologist can do very little, if anything, with images which are formed in so undefined and indefinite a manner.

On the other hand, there is a question which acquires enhanced importance, viz., whether it is possible to establish satisfactorily the more natural conception that what is seen in the microscope can be taken as a representation detail by detail of the object, and what, if this be so, are the conditions for the realisation of such image formation. I have dealt with this question in a paper which has just appeared in the *Zeitschrift für Physik*, and will give here a brief account of its contents.

The fact that light has a finite wave-length not only indicates the existence of a definite limit of resolution, but it also defines a limit for the recognition of the condition of coherence. E. Verdet was the first to deal with this point. If we take a small element ϵ in a light source, which element is small compared with λ/A_s , then the monochromatic radiation which passes from this element through any chosen aperture A_s is, so far as we can possibly tell, completely coherent, i.e. such lack of coherence as may exist in this light could not possibly be detected by experiment. By means of a simple geometrical construction it is possible immediately to deduce from this statement another which makes a similar statement about the rays coming from an *illuminated* object.

If in this object we take an element of area δ , which is very small compared with $\frac{\lambda}{A\delta}$, where $A\delta$ is the aperture of the illumination, then all the rays leaving the element δ can be considered as entirely coherent, so far as we can ever tell, irrespective of where the rays originate, whether they come from one or from several sources, and irrespective of whether they are refracted, scattered, or reflected in the object. The sole exception to this arises if the object emits any secondary radiation such as might result from some luminosity of the object. On this statement is based that on which Lord Rayleigh built up his theory of image formation. His condition for the limit of resolution is that the diffraction phenomena due to neighbouring elements in the object shall not overlap, and is written as

$$l \geq \frac{1 \cdot 22\lambda}{A_o} k \quad . \quad . \quad . \quad . \quad . \quad (2)$$

where A_o is the aperture of the object-glass, and k is a quantity which depends principally on physiological factors, being in general less than unity. This formula can only be applied safely, however, if the aperture of illumination is at least equal to the aperture of the object-glass. For other conditions of illumination the limit of resolution is given by the condition which can be stated generally as

$$l \geq \frac{C_1\psi_1 + C_2\psi_2}{\beta'} K \quad . \quad . \quad . \quad . \quad . \quad (3)$$

where C and ψ are undefined diffraction functions, the particular values of which have to be determined for each individual case, and β' is a commensurability factor. For the case in which an aplanatic object-glass is used with full-aperture illumination, these quantities have the following values—

$$C_1 = C_2 = \frac{1}{2}; \quad \psi_1 = \psi_2 = \frac{1 \cdot 22\lambda}{A'_o}; \quad \beta' = \frac{A_o}{A'_o},$$

in which A_o is the aperture of the object-glass on the *object* side, and A'_o is the aperture of the object-glass on the *image* side. This, then, gives Lord Rayleigh's formula. If all the possibilities involved in the general formula (3)

are investigated, it is shown that the optimum conditions of resolution are obtained in many instances if *annular* bright-ground illumination is used, which can be made to extend some considerable amount above the value corresponding to full-aperture illumination. The useful application of such illumination demands, however, the use of object-glasses having particularly good correction in their outermost zones. Since with the limits given by (2) or (3) the diffraction effects produced by individual details in the object just do not overlap in the image so as to obliterate each other, these formulæ give at once the limits up to which it is possible to correlate what is seen in the image with what exists in the object-structure.

At this stage it is specially worthy of note that this representation of the mode of formation of optical images, which I have called the equivalence theory because of the considerations of coherence on which it is based, does not exclude the Abbe theory; it merely puts that theory into its proper place. We come down to the Abbe theory if we look into the question of the formation of images of such details as have dimensions smaller than the value of l , which satisfies the condition given in (3) above; such details *cannot* have their images formed in the sense that the image obtained will be a true representation of the object-detail. By the overlaying of the individual diffraction effects which are produced under these conditions, secondary interference effects are obtained; in these, effects produced by object-details smaller than the limit of resolution (as calculated according to formula (3)), are, under suitable conditions, made visible in the image, but the appearance thus obtained cannot be related to the object-structure in any definite and unquestionable way unless the nature of the object-structure is already known.

Although there are yet many points to be dealt with in considering this statement (of the equivalence theory), as, for example, in connection with the evaluation of formula (3), yet these preliminary (or fundamental) considerations are sufficient to show that the equivalence theory is the more suitable one (as compared with the Abbe theory), since it gives a satisfactory explanation of the results obtained in practice and also supports the methods employed in practice. It should also be evident, from what has been said, that, in addition to the above, it is the more generally applicable statement of the processes involved in dealing with image formation.

XXII.—THE FORMATION OF IMAGES AND THE RESOLVING POWER OF MICROSCOPES.

By ALFRED W. PORTER, D.Sc., F.R.S.,

Emeritus Professor of Physics in the University of London.

(Read March 20, 1929.)

THREE TEXT-FIGURES.

THERE is, it appears to me, an unfortunate nomenclature growing up in regard to the methods of dealing with microscopic images. In reality both Abbe's and Rayleigh's *methods* are applications of *diffraction* theory; hence it is misleading to apply the term only to Abbe's method. Again, there is nothing in Rayleigh's work suggesting that self-luminous and illuminated bodies are necessarily *equivalent* to one another; in fact, he was always carefully distinguishing between the two cases, and therefore the term "equivalence theory" is quite inappropriate. In reality diffraction theory governs both methods, but it is applied in different ways by Abbe, Rayleigh, and others. All employ the results of Fresnel and Fraunhofer in lieu of a more exact electro-magnetic theory which it is impracticable to employ. The use of these approximate methods is not likely to lead to any important error and need cause no worry.

Now, the division between the two chief schools is in the choice of *method*. Rayleigh has made straightforward applications of diffraction theory to so many phenomena, i.e. to various kinds of objects, various kinds of illumination, and various apertures, especially in his 1896 paper, that he has left very little domain open for new explorers. I take it there is no serious question about the legitimacy of the processes he employs or of the results obtained. Anyone who studies the question in Rayleigh's manner will soon learn that resolving power is not a property which can be specified with any precision for a particular lens, since it depends upon the kind of object and of illumination. Moreover, the practical resolving power depends upon other things besides the wave theory, because it is impossible to design a lens which is perfect from the point of view of geometrical optics. Rayleigh has dealt with many cases in which the objects behave as independent and also many in which phase relationships exist between the beams that they send to the lens. The general conclusion is that there is gain in a large

"aperture" (N.A.); there is further gain if only the peripheral part of the aperture is used, though he gives a reason for not overdoing this.

When we turn to Abbe's method (Rayleigh calls it the "spectrum method"), we are obliged to recognise that it is more limited in its application. Abbe limited it to regular rulings illuminated by a parallel beam. The rulings thus constitute a diffraction grating, and ordinary Fraunhofer spectra will be found in the back focal plane of the objective. [If the illumination is not a strictly parallel beam, diffraction spectra are still formed differing very little in position. Very little has been done in calculating their precise character.]

Abbe showed that, any rate in the rough, the final image can be calculated by treating these spectra as sources—the final image being simply the interference pattern formed by the lights emanating from the spectra that are present. Abbe must, I think, have been quite right in coming to this conclusion. But he never carried out the necessary calculations with any rigour; in fact, he made only the simplest kind of deductions, and it is necessary carefully to distinguish between Abbe's method and Abbe's practical use of it. With only one spectrum present there are no details in the image; with two spectra interference lines appear in the image space: there is a beginning of resolution. The resolving power so calculated comes out at half Rayleigh's approximate value for two independent objects; the difference between the two cases is easily explained by the difference in character of the illumination. For oblique illumination the "central" spectrum moves to one edge of the field; the first order spectrum will then be close to the other edge for rulings twice as close as before. These results and others like them are useful, but we must be careful not to attribute to them greater precision than they possess. For example, no cognisance is taken of the aperture being *circular*. Nor is any allowance made for the fact that the spectra are not bright *lines* even when the "lines" on the object are very narrow and the source is also a line; each is a more or less broad patch, the breadth of which is determined by the total number of rulings on the grating that is being examined, or at least on the total number that are sending light to the eye.

Unless these circumstances are taken into account, it is impossible to say precisely which will be the character of the interference figure in the image plane. It is possible to calculate these interference fringes, but the result is too complicated to be of any use in the problem of resolving power. Yet one complication ignored by Abbe *must* be recognised. Besides the spectra which he discusses there are intermediate ones known as secondary spectra. These are of importance, though they have been treated as the Cinderellas of the subject—that is, practically they have been ignored. When there are three narrow bright lines in the object, the amplitude of the light in the back focal plane is distributed as in fig. 1; when there are *four*, there are two secondary spectra between each pair of principal spectra; when there are n bright lines on view, there are $n-2$ secondaries between successive principals.

The above is for bright lines narrow compared with the "bars" or opaque portions of the grating. When the bright lines and bars are of equal width, the distribution of *intensity* in the spectra is more like fig. 2; each character of ruling has, indeed, its characteristic distribution curve. Abbe's determination of the limit requires the presence of the central and the first maximum, but no recognition is taken of the intermediate secondaries.

The amplitude of the light in a secondary adjoining a principal spectrum is never as little as $\frac{1}{3}$ that of the principal. If one of these secondaries is present, and still more with two present, a certain amount of resolution is obtained even when the grating is twice as closely ruled as in Abbe's limiting case. It is not a difficult experiment to make with a set of test-rulings.

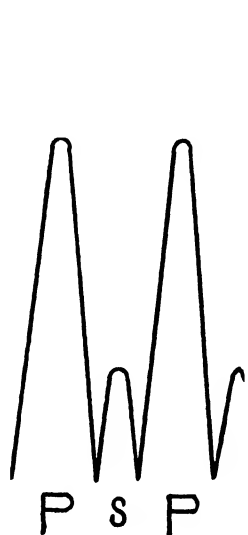


FIG. 1.—Amplitudes for three narrow openings.

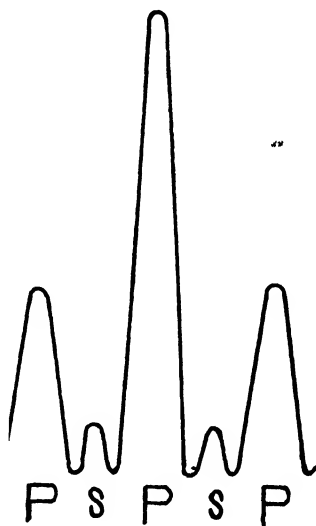


FIG. 2.—Intensities for three openings and three equal bars.

Johnstone Stoney showed it to me more than twenty years ago with the fine rulings on a diatom.

I hope I will not mislead you into thinking that this is of great importance in practice. It would be of importance only if it were thought that a precise value of resolving power could be specified. Ordinary objects scarcely ever exhibit such regularities that the secondaries can produce their maximum effect. My purpose in mentioning these facts is to emphasise that Abbe's method as usually applied cannot claim to give a complete answer to questions concerning the formation of images even for the kind of object with which he deals. In other words, I cannot subscribe to the conclusion of Mr. Moore (at the bottom of p. 141). Yet I consider that if the lens system could gather together all the lights emerging from the object and bring them together in appropriate places *and phases*, a replica of the object.

would be obtained ; it seems to me that the principle of retraceability of rays demands that this shall be so. Abbe, however, never put the statement quite as fully as I have just done.

In spite of its deficiencies, I consider Abbe's method a very instructive one, and I have shown his experiments in my classes at University College for over thirty years. But, at best, it makes use of only one out of an infinite number of modes in which a light beam can be *supposed* to be split up. When a writer asserts that an image is (or is not) formed according to Abbe's "theory," he must be taken to mean that he has (or has not) adopted Abbe's method of resolution. Owing to the difficulty of dealing with whole effects in physics, it is customary to divide phenomena into elements and assume the additive law. But Nature cares nothing for our imaginary elements ; it is the resultant thing that happens and that is independent of our modes of resolution.

EXPERIMENTS OF ALTMANN AND MANDELSTAM.

I now turn to the experiments with glowing gratings. The lights from the separate wires are independent of one another ; in Abbe's experiments the lights coming from his rulings are phase-correlated. Yet there is similarity in the interference fringes produced in the image plane in the two cases when slit diaphragms are interposed. At first this is surprising, but a little examination will remove any initial unexpectedness. It is necessary to inquire what will be the effect of a *single* glowing wire, for the

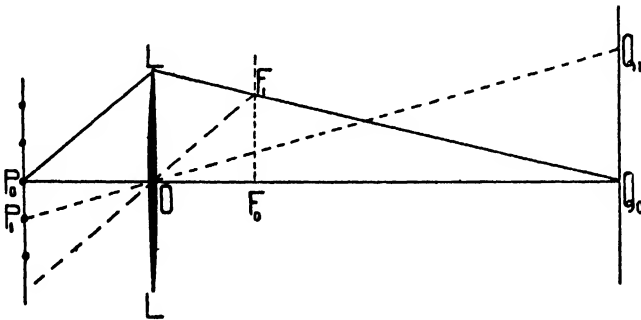


FIG. 3.

lights from the separate wires are uncorrelated and cannot interfere. A diagram (fig. 3) will assist in giving the answer. The objective is LL and the glowing wires are P_0, P_1 , etc. Mandelstam placed slits at F_0 and F_1 in the back focal plane *in the positions at which Abbe placed slits* when he wished to select any particular spectra. It is important to observe that F_0, F_1 itself constitutes a *grating* having two openings ; further, it is illuminated by a source P_0 , and consequently a series of Fresnel fringes will be formed in the image region. Let Q_0 be the position of the geometric image of P_0 and Q_1

that of the next wire F_1 . Calculate the interference fringes in the plane Q_0Q_1 . The ordinary methods of doing this may not be convincing, but the required results can be easily obtained by a consideration of optical paths starting at the source itself—the optical length of a path will be indicated in square brackets. We suppose the objective perfect from the point of view of geometric optics; it follows that $[P_0LF_1Q_0] = [P_0F_0Q_0]$. Also $[P_0LF_1Q_1] - [P_0F_0Q_1] = \text{path retardation, } \Delta, \text{ at } Q_1$. Comparing these equations:

$$[F_1Q_1] - [F_1Q_0] - [F_0Q_1] + [F_0Q_0] = \Delta;$$

or algebraically

$$\sqrt{a^2 + (y - \xi)^2} - \sqrt{a^2 + y^2} - \sqrt{a^2 + \xi^2} + a = \Delta$$

which is approximately

$$\frac{(y - \xi)^2 - y^2 - \xi^2}{2a} = \Delta = -\frac{y\xi}{a}.$$

Now, this is precisely the expression by which in Abbe's experiments the interference fringes are calculated so that the fringes will be equally spaced in the two cases. But it is certain that the geometric image of the object is in the same place in both cases; in Abbe's case it coincides with the fringes, and therefore it must also do so in Mandelstam's.

Is there, then, no difference between the two cases? No, there is a great difference. In Mandelstam's case it is necessary to place slits at F_0 and F_1 in order to get fringes at Q_0Q_1 , otherwise the light is practically uniform in the back focal plane; in Abbe's case the diffraction spectra serve as their own slits. That is a very essential difference. It leads to a different character of final image. When slits are used by Mandelstam, the light let through is not precisely like the light from spectra, which, as I have already explained, is more complicated in kind than even Abbe recognised. All that can be decided in the simple way given above is that the images obtained by the two investigators should be roughly alike. If by altering the aperture the "spectra" or slits used are twice as far apart, the fringes will be twice as close in both cases, and so on.

The effect of the introduction of a slit is very much the same as in an experiment of Johnstone Stoney which by many is considered to be of the nature of a paradox. A spectroscope is taken in which the prism is replaced by a diffraction grating. The source of light in usual practice is focused on the collimator slit, and a parallel beam falls on the grating. The illumination of the various parts of the grating is therefore phase correlated and the resolving power is correctly calculated by taking this phase correlation into account. In Johnstone Stoney's modification the slit is first opened *very* wide and the source (the disc of the sun, for example) is focused accurately upon the *grating*, so that the various parts of the latter are now

illuminated by rays that have no definite phase relationship, and the condition for high resolving power is violated. Afterwards, *without disturbing the arrangement of the lighting*, the slit is closed to its usual working width; the resolving power is now found to have the same high value as in the first case. Now, if the grating has 100,000 lines, say, and in one case the phases are correlated and in the second case they are not, the resolving power ought to be reduced in the ratio of 100,000 to unity! The explanation which I have given in connection with Mandelstam's experiments is the one that is applicable here. When the slit is narrowed down, diffraction spreads the rays coming from *one line of the sun* so that they cover the whole grating; the resolving power has now become the same as in the ordinary use of the grating. I say nothing about the *amount* of illumination in the spectra—that is probably much less. Everyone who is puzzled by the question should carry out this experiment himself. It was shown me by Johnstone Stoney, in his private laboratory, with all the meticulous attention to details of which he was capable. My recollection is that he afterwards showed it at a Royal Society conversazione.

WIDE-ANGLE ILLUMINATION.

Abbe selected parallel illumination. Probably he did so without any intention of suggesting that parallel illumination is best, but because it enabled him at once to make use of all the results of Fraunhofer and Schwersd in connection with diffraction images.

If by wide-angle illumination is meant that by means of a condenser a beam of wide angle is focused on (as nearly as possible) one point of the object, we are back again at the equivalent of a self-luminous object. The question of the desirability of securing that the whole objective is utilised in the formation of the image of that point is answered most simply in the manner adopted by Rayleigh. The answer is that the wide-angle illumination is advantageous. If only a parallel beam is used, the object (a histological section, for example) will scatter the light to some extent, but not so as uniformly to fill the objective with light. Abbe's method does not give a different answer—it gives no answer at all. The condenser should therefore have a value of N.A. at least equal to that of the objective; in the case of an immersion lens this will usually require that the immersion principle be used for the condenser also.

Rayleigh's calculations indicate that in general there is an advantage in making the illuminations from different points of the object independent of each other. This requires that the source be focused as accurately as possible upon the particular section of the object which is being examined. The scattering of light within the microscopic specimen itself will always put a limit to the success with which this can be effected; this will therefore diminish the resolution.

It should be remembered that it is not enough for the light to reach all parts of the objective. The best effect may be obtained when the illumination near the periphery is actually greater than near the centre. If, on the other hand, it falls off from the centre outwards, it is quite possible for the image of a point to become a *double-point* (surrounded by diffraction rings). One function of the condenser in increasing the resolving power (when it is properly used) is to prevent this occurring.

XXIII.—NOTE ON THE ABBE THEORY.

By B. K. JOHNSON, F.R.M.S.

(Read March 20, 1929.)

AT a time when this controversial subject is again being raised, it may be of interest to remark on some recent quantitative tests made on the resolving power of microscope objectives given in the Society's Journal, vol. xlviii, pp. 144-58.

Whilst the figures obtained in these experiments agree closely with Abbe's limit "under the most advantageous conditions" (namely, $\frac{5\lambda}{N.A.}$ for "oblique illumination"), for "direct illumination" the results obtained more recently do not agree with either Abbe's or Airy's strict theoretical values. If, however, the reduced imaged object (mentioned in paper) is treated as a self-luminous object being observed by a lens system whose resolving power is given by the relation $\frac{1.22 \times \text{wave-length}}{\text{effective aperture of lens}}$, and provided one modifies this theoretical figure of 1.22 to the now more generally accepted experimental diameter of the Airy disc to $.7$ or $\frac{.6\lambda}{n \cdot \sin U}$, the "direct illumination" results agree well with such a figure and certainly appear more understandable on this principle.

Thus the practical measurements on the limit of resolution agree, for particular cases, with either the Abbe or the (modified) equivalence theories, and from experimental evidence, therefore, such a fact makes it difficult to form justly an opinion in favour of one theory more than the other.

XXIV.—MODE OF FORMATION OF THE IMAGE IN THE MICROSCOPE.

By H. MOORE, D.Sc., A.R.C.Sc., F.Inst.P.

(*Paper read at the discussion on March 20, 1929.*)

THREE TEXT-FIGURES.

It may be well, before attempting to reply in detail to the points raised, to define precisely the main point at issue. The nomenclature of the subject has been unfortunate, as Prof. Porter has reminded us; I will start, therefore, by attempting to distinguish in a more or less general way between some of the many types of effects which are described as diffraction and interference phenomena.

Firstly, there are diffraction effects such as are produced when only a limited portion of a wave-front is allowed to pass through some aperture: the effects produced by obstacles in the path of a light beam are of a similar type to these. If the aperture is a diaphragm surrounding a well-corrected lens, this type of diffraction effect can be most readily studied by causing the lens to produce an image of an isolated point source. In the true image plane the image appears as a bright "diffraction disc" surrounded by alternate dark and bright "diffraction rings," but to appreciate the effect completely, the appearance produced in planes on either side of the true image plane should also be observed.

Secondly, we have the type of diffraction effect produced by fine regular structure such as the lines of a diffraction grating. Such a structure gives rise to diffracted beams travelling along definite directions in a manner which is well familiar to all of you.

In both these types of effects the variation of intensity in any plane across the path of the light is due to "interference," i.e. to the vibrations reinforcing each other at certain points and neutralising each other more or less completely at other points.

A third effect is that which is especially associated with the name of Fresnel. This type of effect is obtained when two (or more) images of a source of light (or of an illuminated narrow slit) are formed side by side at a small distance apart. In the portion of space through which light from any two (or more) of these images passes, "interference fringes" are formed in any plane across the paths of the light beams.

Other types of interference effects might be referred to, such as those

obtained with a Michelson interferometer, but we are not concerned with these in the present discussion.

Let me add at once that these effects are not to be taken as fundamentally different from each other ; I have merely separated them in the above way for convenience of reference.

And now let me lead up to Abbe's theory by describing what happens when an illuminated regular structure, such as a diffraction grating, is examined under the microscope, the cone of illumination being of quite small angle. The following three separate processes go on : (1) the production of diffracted beams by the object-structure, (2) the focusing of these beams by the object-glass so as to produce, behind the object-glass, multiple images of the source, and (3) the formation of interference fringes in that part of the microscope tube where the beams from the different images of the source overlap. If the cone of illumination is wide, these same three processes occur, but the direct image of the source may overlap the diffracted images, rendering these invisible. In addition, the interference fringes produced by different portions of the images of the source will be superposed upon each other, and they may overlap each other in such a way as to produce a uniform intensity of illumination. In these circumstances, although interference must still be going on, no visible fringes would be produced, and we should have no *visible* evidence that interference of the Fresnel type was taking place at all.

These three processes occur in consequence of the nature of light ; their existence can be deduced from and explained by the wave theory of light. They are the basis of the Abbe theory, but their existence is in no sense deducible from or explainable by that theory. The Abbe theory is essentially the statement that the only type of "image" which can be produced in the microscope is of the nature of an interference effect of the Fresnel type, i.e. that the image seen is the interference fringe or interference pattern which lies in the focal plane of the eyepiece.

At first Abbe put forward the view that images of coarse structures can be formed by dioptrical processes, i.e. by the same processes as are involved in producing the images of self-luminous objects. For fine structures, however, Abbe held that dioptrical images could not be obtained, the only type of "image" obtainable with such structures being of the nature of interference fringes or of an interference pattern of the Fresnel type. Later on Abbe extended his theory and made it apply to all objects seen under the microscope, stating that with any type of object, under any conditions of illumination, the image obtained with the microscope could not be considered as a true or "dioptric" image, but only as an interference appearance produced in the manner described above.

As a direct consequence of this view, Abbe drew the conclusion that under no conditions could it be assumed that the object bore any precise resemblance, detail by detail, to the image obtained, though the image might possess different "degrees of similarity" to the object, the degree of similarity

increasing as the number of diffraction maxima taken in by the object-glass became larger.

As my authority for stating Abbe's theory in this way, I will refer to "The Microscope and its Revelations," by Carpenter, 7th edition, in which the first seven chapters were entirely rewritten by Dallinger.

In chapter II of this work we have the statement that "microscopic vision is *sui generis*. There is, and can be, no comparison between microscopic and macroscopic vision. The images of minute objects are not delineated microscopically by means of the ordinary laws of refraction; they are not *dioptrical* results, but depend entirely upon the laws of *diffraction*." Later Dallinger refers to the fact that "Dr. Abbe has read the entire chapter and . . . feels 'the greatest satisfaction in seeing his views represented . . . so extensively and intensively.'" A lengthy quotation is then given from a letter written by Abbe to Dallinger in which Abbe states that he no longer holds that there are two types of images obtainable with non-luminous objects, viz., the "absorption" image (or direct dioptrical image) and the "diffraction" image. Reference is made in this letter to experiments with a lens of 12 in. focal length, viewing gratings of not more than 40 lines per inch. The results obtained in these experiments, coupled with more exhaustive theoretical considerations, had led Abbe to revise his earlier view "that coarse structures (or the outlines of objects containing fine structure) were depicted by the directly transmitted light solely, without the co-operation of diffracted beams," and to conclude that "there must always be the same conditions of delineation as long as the objects are depicted by means of transmitted or reflected light whether the objects are of coarse or very fine structure." Later on, in the same chapter, some experiments are described, the descriptions being prefaced by: "The following experiments will suffice to show . . . that to the action of diffraction spectra we are indebted for microscopical delineation."

This is probably sufficient authority for the statement of the Abbe theory in the form which I have just given, but it may be worth while referring also to Dippel's "Handbuch der Mikroskopie," in which a short and entirely unequivocal statement is given of the Abbe theory. This statement had been read and sanctioned by Abbe. I will give here a translation of two short paragraphs contained in that statement: "There is no invariable and unconditional relation between the visible image of the object and the actual character of the object. Such a relation exists rather between the image and the diffraction spectra which give rise to it. Consequently, nothing can be deduced with certainty from the appearance of the image except that there are such relations between the structure details of the object as can give rise to the diffraction spectra."

"The theory of image formation in the microscope briefly outlined here is quite general and holds good for every type of structure, and includes, therefore, the whole range of objects which can be examined by the microscope."

Before going on any further I think I might deal with some of the remarks that have been made during the discussion, in which the view has been expressed that Abbe's theory does not clash with the equivalence theory or with any other theory which permits of the possibility of the formation of dioptrical images. Abbe's theory denies that such images can be formed, and the theory itself is, therefore, irreconcilable with any of these dioptrical theories.

Other points which have been raised in support of the Abbe theory can best be dealt with by considering certain consequences of that theory. I propose, in considering these consequences, to take Abbe's theory in what

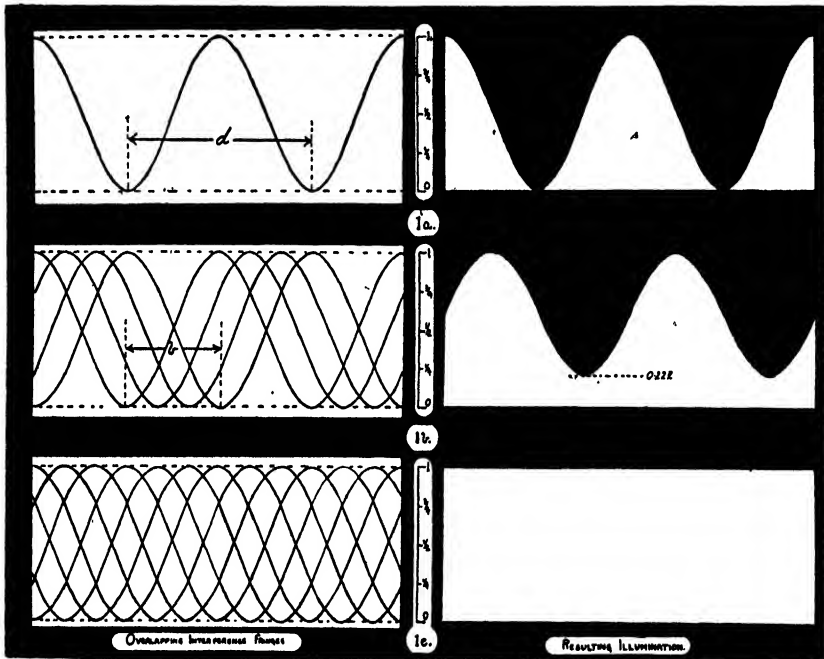


FIG. 1.

may be called its unrestricted form, as finally propounded by him, and to determine what type of contrast would be obtainable in the interference fringes under certain readily reproducible conditions. In one of the examples I have dealt with what would be found with an Abbe "Diffractions-Platte" viewed by means of a Zeiss *aa* lens. I shall show that under the ordinary conditions in which the microscope is used, contrast in the interference fringes becomes negligible, so that the fringes are entirely invisible. If, therefore, it is only as an interference pattern or as a system of interference fringes that the structure of an object can be delineated, we should see nothing whatever in the eyepiece, under ordinary conditions of working, except a uniformly illuminated area. Even with quite small cones of illumination

the contrast obtainable would be very small, and the interference patterns would be seen only with great difficulty. The fact that the microscope can be used at all with large cones of illumination, and that sharp images with well-marked contrast can be seen under these conditions, shows that such images cannot be of the nature of interference fringes or interference patterns, and, therefore, that Abbe's theory is untenable.

First let us consider a ruled grating illuminated by light from a distant small source, the illumination being oblique, and arranged so that the first diffraction spectrum is inclined to the axis of the microscope at the same angle as the directly transmitted pencil. We will imagine that only the direct beam and one of the first order diffracted beams can enter the object-glass. In the second principal focal plane of the object-glass two images of the source will be formed, and the two beams of light proceeding up the microscope tube from these images will cause interference in the region in which they overlap. In any plane across the microscope tube in this region we shall have an interference pattern in which the intensity of illumination will vary in the manner indicated in fig. 1 (a).

The effect of increasing the size of the source will be to make the two images of the source larger. Any pair of corresponding elements in these larger images will give rise to an interference pattern of the type already referred to (fig. 1 (a)). No confusion should arise on this account, however, (according to Abbe), since the "image" (the interference pattern) due to each narrow element of the source will have the same "degree of resemblance" (as defined by Abbe) to the object as that due to any other element. The effect of broadening the source is indicated in the series of diagrams 1 (a), 1 (b), and 1 (c), the various interference patterns being displaced laterally relative to each other.

These figures represent the interference fringes produced in some particular plane by different pairs of corresponding points in the images, and the resulting intensity of illumination in that plane when the widths of the images are

- (a) infinitesimal,
- (b) equal to *half* the distance between two adjacent interference lines in the selected plane, and
- (c) exactly equal to the distance between two adjacent interference lines in that plane.

It will be observed that the intensity indicated in fig. 1(c) is uniform, i.e. the interference fringes in the particular plane chosen will be entirely invisible under these conditions. As the size of the source is further increased, conditions giving visible fringes in this plane will alternate with conditions in which the intensity of illumination is uniform and the fringes are invisible.

If we denote the intensity of the brightest part of the interference fringes by I_{\max} , and the brightness of the darkest portion of the interference fringes

by I_{\min} , the visibility of the interference fringes can be expressed in terms of the quotient

$$\frac{I_{\max} - I_{\min}}{I_{\max}}.$$

This quotient gives a quantitative measure of the contrast to be seen in the interference fringes. As the angle subtended by the source is increased, the value of this quotient changes in the manner shown in fig. 2. It will be seen that full contrast is not obtainable except with a source of infinitesimal breadth.

For a source which subtends any particular angle at the object, the

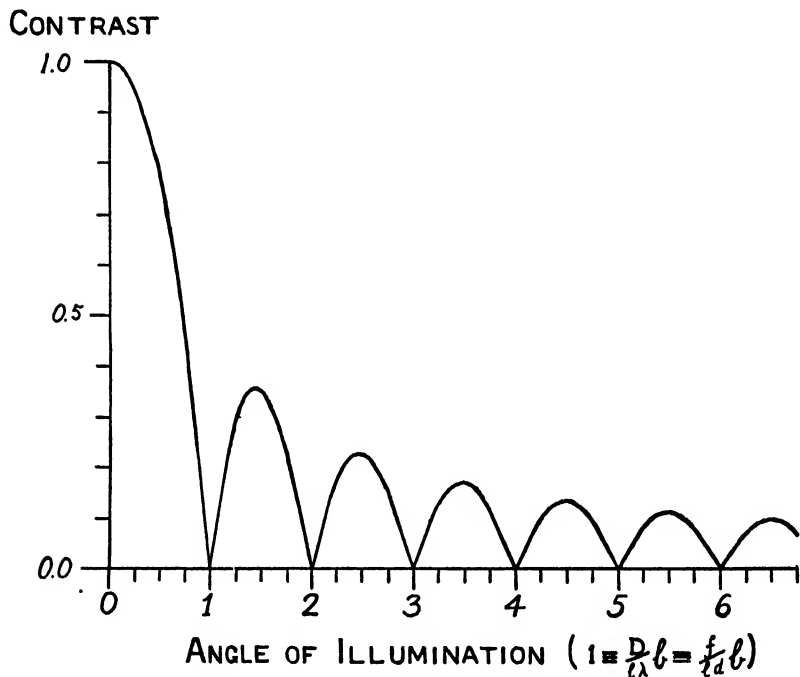


FIG. 2.

degree of contrast obtained in the interference fringes in any particular plane depends on the wave-length of the light used, on the focal length of the lens, on the spacing between consecutive lines in the grating or other regular structure used as object, and also on the distance from the back principal focal plane of the object-glass to the plane in which the interference is being examined. Other things being equal, the finer the structure of the object, the smaller must be the angle subtended by the source to correspond to any particular condition represented in the curve shown in fig. 2.

Fig. 3 serves to illustrate this latter point. In figs. 3 (a) and 3 (b) we have two gratings, the fineness of ruling of the grating shown in 3 (a) being twice that of the grating shown in 3 (b). As a result, the separation (D)

between the direct image and the first diffraction image of the source is twice as great in 3 (a) as it is in 3 (b), the same object-glass being used in both cases. As a further result, the interference fringes in the focal plane of the eyepiece are twice as fine in 3 (a) as they are in 3 (b).

Now, if we use an extended source, so as to make the width of the image of the source exactly equal to the spacing of the interference fringes in the focal plane of the eyepiece, the fringes in this plane disappear. This is shown in fig. 3 (c), which is similar to 3 (a) with the exception that 3 (a) gives

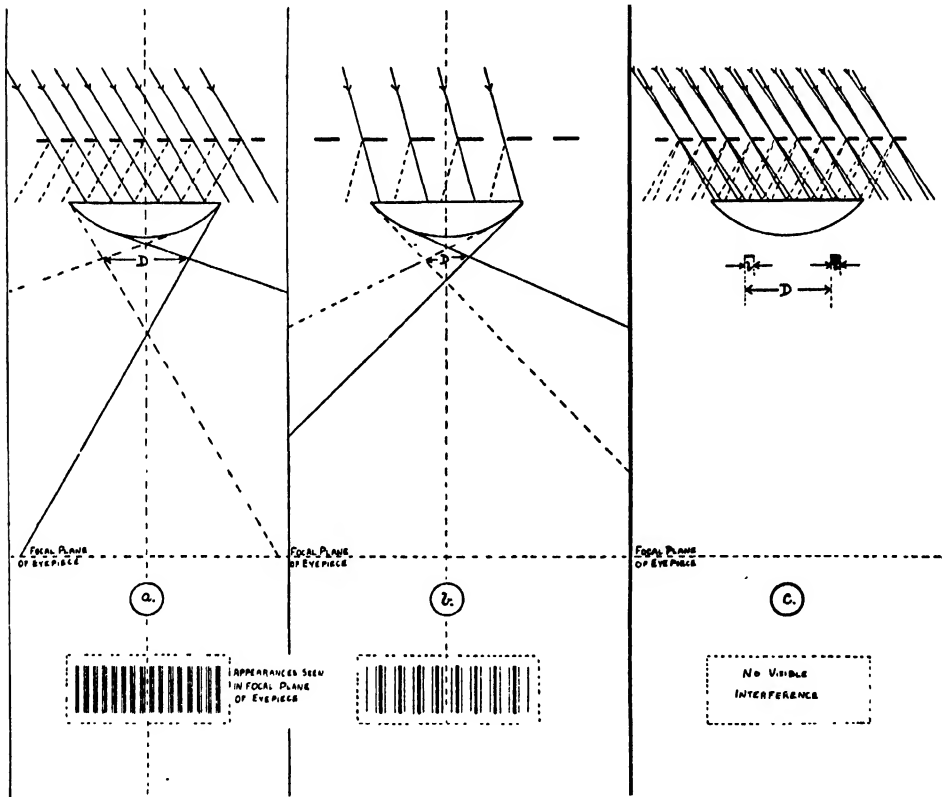


FIG. 3.

the effect which would be obtained with a source subtending an infinitesimal angle, while in 3 (c) the source is supposed to subtend such an angle that the width of its image is equal to the spacing of the interference fringes in the focal plane of the eyepiece.

To produce similar uniformity of illumination with the coarser grating shown in 3 (b), the angle subtended by the source would have to be made large enough for the image of the source to be as wide as the spacing of the interference fringes shown in 3 (b). This would require a source twice as wide as that required to produce the same result with the finer grating.

It would be out of place here to go into details of the method employed for calculating the contrast under any particular set of conditions, but a few results which I have calculated may be of interest. I have chosen the following three examples, in the first of which consideration has been given to the exact conditions of Abbe's own experiment.

Example 1.—The object is an Abbe diffraction plate, spacing interval slightly greater than $1/70$ mm. (almost exactly $1/1750$ in.). The object-glass is a Zeiss *aa* lens of 1 in. focus.

Example 2.—The object is considered to be a grating having 8,000 lines to the inch, the same object-glass being used as in Example 1.

Example 3.—The object is taken to be a grating having 50,000 lines to the inch, the object-glass being a lens of $\frac{1}{2}$ in. focal length (N.A. 0.65). This example corresponds approximately to what would be obtained with *Pleurosigma angulatum* as the object.

In all three examples the interference in a plane 10 in. behind the back principal focal plane of the object-glass is considered.

Conditions giving maximum and minimum contrast in the three examples occur when the source subtends the angles given in the following table:—

Maxima. Minima.		Percentage Contrast.	Angle (in degrees) Subtended by Source.					
			Example 1. Maxima. Minima.		Example 2. Maxima. Minima.		Example 3. Maxima. Minima.	
1st		100	0		0		0	
	1st	zero		0.327		0.190		0.119
2nd		35.7	0.468		0.273		0.170	
	2nd	zero		0.655		0.382		0.238
3rd		22.7	0.805		0.470		0.293	
	3rd	zero		0.982		0.573		0.357
4th		16.8	1.136		0.663		0.413	
	4th	zero		1.310		0.764		0.476
5th		13.2	1.466		0.855		0.533	
	5th	zero		1.637		0.956		0.595
6th		10.9	1.795		1.047		0.653	
	6th	zero		1.964		1.146		0.715
7th		9.4	2.123		1.238		0.772	
	7th	zero		2.292		1.337		0.834
8th		8.1	Here the first order image overlaps the direct image; portions of higher order images also are formed behind the object-glass.		1.430		0.891	
	8th	zero			1.528		0.953	
9th		7.2			1.621		1.011	
	9th	zero			1.719		1.072	
10th		6.5			1.812		1.136	
	10th	zero			1.910		1.191	
11th		5.9			2.003		1.249	
	11th	zero			2.101		1.310	
12th		5.4			2.195		1.368	
	12th	zero			2.292		1.429	
13th		5.0			2.386		1.488	
	13th	zero			2.483		1.548	
14th		4.6			2.577		1.607	

In actual microscope work the contrast obtainable would be much less than that stated in these tables. There are at least two reasons for this:

firstly, monochromatic light would not be used, the interference fringes produced by light of different wave-lengths would thus have different spacing intervals, and, consequently, contrast would be very considerably reduced. Secondly, the values given for the contrast are based on the assumption that the first order diffraction image of the source is of the same brightness as the direct image, which would be very far from the truth in most cases. If either image were brighter than the other, the contrast would be diminished.

Experiments to verify these results have been carried out, using an Abbe diffraction plate and a Zeiss *aa* lens, and also with a grating ruled with 3,000 lines to the inch, using the same object-glass. I will not take up the time of the meeting by describing these experiments in detail, but will content myself by saying that the results obtained were of considerable interest, and that the agreement between them and the results predicted in the table was convincing.

These results must now be considered in relation to the Abbe theory. They show that if white light is used to illuminate an Abbe diffraction plate viewed by means of an object-glass of 1 in. focus, the contrast in the interference fringes formed in a plane 10 ins. behind the back principal focal plane of the object-glass would be quite poor (under 10 p.c.) if the angle of the illuminating cone were of the order of 2° . With a grating ruled with 3,000 lines to the inch in place of the Abbe diffraction plate, contrast would be less than 6 p.c. with a similar illuminating cone, while with *Pleurosigma angulatum* viewed by means of a $\frac{1}{3}$ -in. object-glass, contrast would be less than 5 p.c. with an illuminating cone of about $1\frac{1}{2}^\circ$.

These remarks apply only to the interference pattern resulting from the existence of multiple images of the source in the back principal focal plane of the object-glass. As, however, this interference pattern is the only type of image which can be produced, according to the Abbe theory, we must conclude, if we accept that theory, that for any but the coarsest of microscopic objects, contrast in the image will be very poor if the object is illuminated with white light and the illuminating cone is of 2° angle or more. These are direct quantitative deductions from the known conditions for producing interference of the Fresnel type. Two of these examples have been verified experimentally, the only difference between the theoretical results and those obtained by experiment being that the contrast obtainable experimentally was not so great as that obtained by calculation—for reasons which I have already indicated.

Now, I think that there must be many microscopists who have resolved *angulatum* with a $\frac{1}{3}$ -in. lens of N.A. 0.65, working at a tube length of about 10 ins., and who have obtained excellent contrast even when using cones of illumination greatly exceeding 2° angular aperture. Many microscopists who desire to obtain the best image in respect of fineness of definition without loss of contrast, work with the condenser diaphragm opened up until its direct image behind the object-glass either touches the edges of the first

order diffraction images or else overlaps these to some slight extent. With *angulatum* as object, this involves the use of a cone of illumination having an angle approximating to 30° , and with such a cone visible interference patterns of the Fresnel type would be absolutely impossible in a plane 10 ins. behind the object-glass. If we admit that images are obtainable under these conditions, the Abbe theory must be abandoned, since such images cannot be due to the interference processes which Abbe considered to be the only processes by which images could be formed. To account for such results we are compelled to invoke some "dioptric" process which, if not identical with the process by which the images of self-luminous objects are formed, must approximate closely to this.

DARK-GROUND ILLUMINATION.

We now come to the very important question of resolution with dark-ground illumination. The divergence here between what is directly deducible from the Abbe theory and what is known to the practical microscopist is very strongly marked.

If we illuminate an object with a pencil of light inclined at such an angle that the direct beam does not enter the object-glass, resolution, according to the Abbe theory, is impossible, unless the first and second order diffraction beams enter the object-glass. This means that if an object is just capable of being resolved (using transmitted light) by a lens of some particular numerical aperture a , resolution is not obtainable with dark-ground illumination unless the pencil of illumination is inclined to the axis at an angle corresponding to N.A. of the condenser equal to $3a$. We may take it that the spacing of the details in *Pleurosigma angulatum* is of the order of $1/50,000$ in., so that to resolve it with transmitted light of wave-length $1/50,000$ in. the object-glass must have a numerical aperture of 0.5. According to the Abbe theory, therefore, to resolve *angulatum* with dark-ground illumination it is necessary to use light inclined to the axis at an angle corresponding to a numerical aperture of about 1.5. I think it is fair to say, however, that *angulatum* has, on occasion, been resolved by an object-glass of numerical aperture 0.65 when illuminated by means of a dry condenser with a central stop to give dark-ground illumination. But as this is impossible according to the Abbe theory, we must either deny that such resolution has ever been obtained, or else we must abandon the Abbe theory.

I submit, on these grounds, that the Abbe theory is entirely inconsistent with practical experience. It is true that when we are dealing with certain special forms of illumination and certain types of objects, viz., with extremely narrow cones and with objects of regular periodic structure, we obtain images in which interference fringes are prominently shown, marring the definition of the image. Under these conditions, also, interference fringes can be seen in planes both above and below the image plane. The existence of these effects is directly deducible from and explainable by the

wave theory of light, and the effects are a direct consequence of the nature of light. Their existence does not in any way prove Abbe's theory, as is often assumed; it merely shows that interference effects will become readily visible under conditions similar to those which are regularly used to demonstrate interference effects. Abbe, from a study of these effects, came to the conclusion that they are the only type of visible effect that can be produced in the microscope, if the object is not self-luminous, and that a non-luminous object cannot give rise to a dioptrical image in the microscope. His theory is *based*, therefore, on the effects I have just described, and their existence is not in any way a proof of his theory.

Before going on to consider what sort of theory we must adopt to explain all the types of appearance we can obtain in the microscope, I propose to consider one or two of the outstanding points which are not dealt with directly or implicitly in what I have already said. I will deal first with Mr. Rheinberg's paper. His main point, namely, that the Abbe theory does not clash with the Airy theory or its modifications, I have already answered. With much of the rest of Mr. Rheinberg's paper I find myself in almost entire agreement, and I am sure, from what Mr. Rheinberg has written in certain parts of his paper, that he himself cannot subscribe to the Abbe theory. As a matter of fact, Mr. Rheinberg's views might here and there be taken as an excellent non-mathematical presentation of Professor M. Berek's "consonance" and "dissonance" theory. Much the same type of remark might be made with respect to the views put forward by Captain Ainslie.

With regard to the resolution, which Mr. Beck obtained, of *Amphipleura pellucida* by dark-ground illumination, Mr. Rheinberg has made an ingenious suggestion in an endeavour to reconcile this with the Abbe theory. Mr. Rheinberg's suggestion is that the diatom structure *refracts* the light in such a way as to cause the *direct* beam to enter the object-glass. The resolution is thus obtained really by transmitted light, and as such is not inconsistent with the Abbe theory. But although the individual elements might, by refraction, cause much of the emerging light to be concentrated along certain directions, the diatom as a whole would not act as a *single* prism merely deviating the original beam through some angle. Each element would refract a narrow pencil of rays, but in consequence of the extremely small size of each element, the light would travel towards the object-glass as a "diffraction fan," not as a narrow pencil. Between the light which had passed through any two of the elements there would be path differences, i.e. phase differences, and hence light of different colours would be reinforced along different directions. The light entering the object-glass would, in fact, be a diffracted beam and not a deviated "direct" beam. The saw-edge type of diffraction grating, also referred to by Mr. Rheinberg, would act in a similar manner. It would be a grating of the type which throws the major part of the light of certain wave-lengths into one particular *diffraction* spectrum. It would be this particular diffracted beam, *not* the

direct beam, which would enter the object-glass under the conditions visualised by Mr. Rheinberg. I cannot, therefore, agree with Mr. Rheinberg's explanation of the resolution of *Amphipleura pellucida* which Mr. Beck obtained with dark-ground illumination.

The points raised by Dr. Siedentopf in relation to the measurements of the diameter of a mercury globule are readily explainable, though a lengthy discussion would be necessary if all the possibilities were to be dealt with completely. The light entering the object-glass would be light reflected from a belt round the middle of the globule; errors in estimating the diameter would arise in consequence of (a) blurring of focus, and (b) different widths of the diffraction annuli seen. These effects would act in opposite ways. Due to the different widths of the "diffraction annuli," the difference between the diameters of the images obtained with the object-glass of N.A. 0.95 and with the object-glass of N.A. 0.82 should be 2μ . The actual difference measured is, however, only 0.3μ , the discrepancy between these two values being due to the different extent to which "blurring" of the images is produced as a result of the differences between the focal lengths of the object-glasses used. As a matter of fact, in choosing a mercury globule Dr. Siedentopf chose the worst possible type of object for measuring under the microscope.

And now it is necessary to consider what sort of theory we must adopt to explain the production of images in the microscope, though the complete development of this theory must be left until another occasion. Whatever theory be eventually adopted, it must be capable of explaining all the effects which can be observed with illuminating cones of both small and large angle, using transmitted light, reflected light, or dark-ground illumination. Such a theory must admit of the production of images by dioptric processes, though, in addition to this, it must be capable of accounting for the interference effects which, with certain methods of illumination, can result in a serious marring of the dioptric image. The equivalence theory in its simplest mode of presentation does not satisfy these conditions, because it does not take into consideration the interference effects of the Fresnel type which can be brought into prominence by illuminating the object in certain ways. In practice, also, we cannot readily reproduce the conditions of illumination required for obtaining *complete* equivalence. Nevertheless, the lack of complete equivalence under the conditions of illumination most commonly employed is so slight that this theory may be taken by the microscopist as a very good approximation to the truth.

ABSTRACTS AND REVIEWS.

ZOOLOGY.

(Under the direction of G. M. FINDLAY, M.D.)

CYTOLOGY.

The Eye-Spot in Unicellular and Colonial Organisms.—S. O. MAST ("Structure and Function of the Eye-Spot in Unicellular and Colonial Organisms," *Arch. f. Protistenk.*, 1927, **60**, 197–220, 1 pl., 4 text-figs.). The eye-spots in *Volvox* and *Gonium*, and probably in all the other green colonial organisms, consist of a cup-shaped pigmented structure, a lens located at the mouth of the cup, and photosensitive substance situated between the lens and the bottom of the cup. This substance is probably connected with the flagella by means of a differentiated conducting system, part of a "neuromotor apparatus." The lens is not visible in these forms, but its presence can be established by the fact that the incident light is concentrated, forming two focal spots, a yellowish one in the wall of the pigment-cup near the outer surface, and a bluish green one in the cup near the inner surface. The wall of the cup transmits the longer waves of light, but the shorter blue and green waves are reflected from the inner surface. The pigment-cup, owing to rotation of the colonies on the longitudinal axis, serves, by periodic shading, to produce rapid and extensive changes in the intensity of the illumination of the photosensitive substance in the cup, resulting in rapid changes in the rate of absorption of light by this substance. Changes in the rate of absorption of light produce changes in the action of the flagella, i.e. responses which result in orientation of the organism. There is an eye-spot in each zooid, but those at the anterior are larger than those at the posterior end. In all the species the eye-spot in each of the different zooids in a colony is so situated and orientated that lateral illumination of the colony produces, as the colonies rotate on the longitudinal axis, alternate shading and exposure of the hyaline portion of each eye-spot, but that illumination from directly in front or behind does not. This alternate shading and exposure of the sensitive substances in unorientated colonies causes responses, so that the colonies turn until they are directed to or from the source of light. The eye-spots, therefore, serve as direction eyes, as in the case of leeches and flat-worms. The eye-spots in the unicellular organisms consist of a spoon-shaped pigmented structure and a hyaline mass which contains photosensitive substance. They do not contain a functional lens, and there is practically no selective reflection from the concave surface of the pigmented structure. The eye-spots in unicellular organisms function, as in the colonial organisms, as direction eyes, though, owing to the absence of a lens and of a selective refractive substance, their sensitivity is probably less. There is almost certainly a phylogenetic relationship between the unicellular and colonial organisms studied and the dinoflagellates.

G. M. F.

The Morphology and Functional Interpretation of the Oligodendroglia.—P. DEL RIO-HORTEGA ("Tercera aportación al conocimiento morfológico e interpretación funcional de la oligodendroglia," *Memorias de la real soc. española de Hist. nat.*, 1928, 14, mem. I, 122, 79 text-figs.). The work of del Rio-Hortega in particular has established the presence in the interstitial tissue of the central nervous system of two cellular categories hitherto only vaguely suspected, which are termed the microglia and the oligodendroglia. In this profusely illustrated and exhaustive monograph the normal structure and development of the oligodendroglia are described at length, together with the various abnormal changes which may occur in pathological conditions. Wherever the oligodendroglia occurs it is found in intimate relationship to the nerve fibres. The conclusion is reached that the oligodendroglia is absolutely homologous in the central nervous system with the cells and sheaths of Schwann in the nerves. It follows that the true cells of Schwann are in reality the oligodendroglia of the nerves, and thus of ectodermal rather than of mesodermal origin. G. M. F.

pH of Protoplasm.—R. CHAMBERS ("Intracellular Hydrion Concentration Studies. I. The Relation of the Environment to the pH of Protoplasm and of its Inclusion Bodies," *Biol. Bull.*, 1928, 55, 369-76). Both micro-injection and immersion methods are used on *Amœba dubia* and the unfertilised eggs of *Asterias forbesi* and of *Echinarachnius parma* to determine the effect of exposure to CO_2 and NH_3 on the intraprotoplasmic pH. The pH of intracellular inclusions which stain with neutral red is readily altered by the presence of CO_2 or of NH_3 in the aqueous medium surrounding the living cells, but the presence of these substances in the medium does not change the pH of the protoplasmic matrix nor of the nucleus as long as the cell is alive. J. L.

Cytoplasmic pH of Amœba.—PAUL REZNIKOFF and HERBERT POLLACK ("Intracellular Hydrion Concentration Studies. II. The Effect of Injection of Acids and Salts on the Cytoplasmic pH of *Amœba dubia*," *Biol. Bull.*, 1928, 55, 377-82). The cytoplasm of the living *Amœba dubia* shows considerable power to revert to its normal pH value of 6.9 ± 0.1 after changes in this value have been induced by the injection of salts and acids. No toxic effects result if injected HCl is immediately thus buffered by the cytoplasm. If the quantity of acid injected is too large to be buffered, the affected area of the cell dies and is pinched off. From colorimetric evidence it is found that injected CaCl_2 , MgCl_2 , and AlCl_3 produce a greater amount of acid than that which would be produced by the mechanical injury alone. Unless this is immediately buffered by the cytoplasm, the affected area is pinched off in the case of CaCl_2 , and AlCl_3 , and death of the entire cell takes place in the case of MgCl_2 . When dead, permeability changes in the rounded amœba, causing it rapidly to assume the pH value of the environment. J. L.

Cytoplasmic pH of Amœba.—HERBERT POLLACK ("Intracellular Hydrion Concentration Studies. III. The Buffer Action of the Cytoplasm of *Amœba dubia* and its Use in Measuring the pH," *Biol. Bull.*, 1928, 55, 383-5). The approximate intraprotoplasmic pH can be determined by injecting a series of solutions of known pH into cells coloured by the previous injection of indicator dyes. The intraprotoplasmic pH of *Amœba proteus* and *A. dubia* is found to lie between 6.6 and 7.2, for no colour change is produced in the dyed amœba when injected with the phosphate buffer solutions between these values. The experiments also show that the cytoplasm has considerable buffering power, and that, if sufficient buffer is introduced to change the pH of the cytoplasm, the cell dies. J. L.

Study of Golgi Apparatus and Vacuolar System of *Cavia*, *Helix* and *Abraxas* by Intra-vital Methods.—J. B. GATENBY (*Proc. Roy. Soc. B.*, 1929, **104**, 302–21, 2 pls.). There exists in the animal cell a vacuole or system of vacuoles primitively associated with and probably produced by the argentophil cortex of the Golgi apparatus. During spermatogenesis this vacuolar system may be separate from the Golgi apparatus. The vacuolar system may be outside or within the archoplasm, as is usually the case in mollusca. During oogenesis and gland-cell secretion the vacuolar system functions most importantly. It is suggested that in oogenesis the Golgi elements are able to produce vacuoles and to condense in them such substances as fats, lipins, and, in glands, zymogen.

G. M. F.

X - Radiation and Spermatogenesis in the Guinea - Pig.—J. B. GATENBY and S. WIGODER ("The Effect of X-Radiation on the Spermatogenesis of the Guinea-Pig," *Proc. Roy. Soc. B.*, 1929, **104**, 351–70, 4 pls.). It is suggested that the specific effect of X-radiation on cell mitosis is due to the temporary breaking down of certain lipid substances necessary for mitosis. This lipid substance is supposed to be located in the cortex of the sphere (Golgi apparatus). In a number of experiments it has been found that after X-radiation the Golgi lipid cortex becomes flocculent and granular instead of smooth. As Strangeways and Hopwood found that the cell is most radio-sensitive just before prophase, it is suggested that at this period the cell is in a state in which recovery from the effects of broken-down lipids is impossible, so that abnormal mitosis leading to death results.

G. M. F.

Ciliary Movement.—P. R. LIEBERMAN ("Ciliary Arrangement in Different Species of *Paramecium*," *Trans. Am. Micr. Soc.*, 1929, **48**, 1–11, 2 pls.). The relief-staining method of Bresslau and of Coles was employed to study the ciliary movement in eight species of *Paramecium*. In all species the arrangement of ciliary rows on the dorsal surface is similar: the rows are parallel to the long axis except towards the ends, where they converge. On the ventral surface there is a preoral and a postoral line or suture against which rows of cilia terminate. The two groups of species described by Woodruff (*Biol. Bull.*, 1921, **41**, 171) can be differentiated also by their ciliary arrangement. In the "caudatum group"—*P. caudatum*, *P. aurelia* and *P. multimicronucleata*—the rows of cilia on the right side of the preoral suture run parallel to this line (left side in the ventral view). In the "bursaria group" none of the ventral rows of cilia are parallel to the preoral suture in the region anterior to the cytostome, but they bend toward and terminate against this line. In the "caudatum" group the species can be differentiated to a certain extent, as in *P. caudatum* there are more rows of cilia in the anterior part of the animal than in *P. aurelia*, although this is probably due to the greater length of *P. caudatum*. In the "bursaria" group the species cannot readily be differentiated.

G. M. F.

The Osmiophilic Bodies of the Protozoans *Stentor* and *Leucophrys*.—O. PARK (*Trans. Am. Micr. Soc.*, 1929, **48**, 20–29, 2 pls.). Osmiophilic structures similar to those described as Golgi bodies in certain other protozoans are found in the non-parasitic freshwater ciliates *Stentor coeruleus* Ehr. and *Leucophrys patula* Ehr. With the Kolatschev-Nassonov osmic acid technique these bodies appear as knob-like elevations applied to the meganuclear surface. The contractile vacuolar system did not blacken following impregnation. It is suggested that these osmiophilic bodies are associated with the process of secretion.

G. M. F.

The Histological Features of Striped Muscle.—D. E. DENNY-BROWN ("The Histological Features of Striped Muscle in Relation to its Functional Activity," *Proc. Roy. Soc. B.*, 1929, **104**, 371–411, 2 pls.). In the mammalian striped muscle groups there occur muscle fibres which differ in the speed of the contraction process. The arrangement is such that fibres of similar speed of contraction form a group which is sharply delimited from other such groups and in most situations forms a muscle "head" such as in the internal short head of triceps. In any such groups of muscle fibres histological differences between the constituent fibres are evident, and occur mainly as differences in content of granules and in fibre diameter. Since the structure of muscle is such that each fibre is able to contribute an effect to the total isometric tension, the occurrence of the histological differences between fibres of similar contraction process reveals that these differences have no direct relationship with the speed and nature of the contraction process in the fibre. The granulation of the striped muscle fibre varies with the nutrition of the animal, and appears to be a form of storage of complex substances which can be stained by an alkaline solution of Sudan III. G. M. F.

Septineuritis Due to Ultramicroscopic Viruses.—S. NICOLAU, O. DIMANESCO-NICOLAU and I. A. GALLOWAY ("Étude sur les septinévrites à ultravirus neurotropes," *Ann. de l'Inst. Past.*, 1929, **43**, 1–88, 2 pls., 31 text-figs.). By septineuritis is meant the generalisation of neurotropic ultraviruses by means of the nerves throughout the nervous system, central, visceral and peripheral with the production of definite lesions, not only in the nerve trunks and small nerve fibres, but also in the neurones situated in the plexuses and viscera. The idea of a septineuritis produced by invisible viruses in the nervous system is thus similar to the idea of a septicæmia produced by visible microbes in the blood. An experimental septineuritis can be produced by the virus of encephalomyelitis (Borna's disease), by the viruses of vaccinia, herpes, poliomyelitis, and by street and fixed rabies virus. G. M. F.

Tissue Culture of Rabbit's Blood.—T. VASILIU and V. STOICA ("Culture *in vitro* du sang du lapin," *Compt. rend. Soc. de biol.*, 1929, **100**, 691–2). The medium used was rabbit plasma and chick embryo juice. The red cells and polymorphonuclear leucocytes had disappeared within twenty-four hours, while the number of lymphocytes had decreased. Mononuclears became more numerous and finally gave rise to fibroblasts and giant cells. G. M. F.

Blue Chromatophores in the Skin of the Frog.—A. HADJIOLOFF ("Les chromatophores bleus dans la peau de la grenouille," *Compt. rend. Soc. de biol.*, 1929, **100**, 669–71). The blue chromatophores are found in the skin of the digits of the hind feet of *Rana esculenta* and *R. fusca*. The cells are branched with short thick processes which ramify round the orifices of glands. The protoplasm of the cells is filled with rounded granulations 0.5μ in size and resembling the granules of methylene blue in colour. The nucleus is oval and is centrally placed. The colour of the cells is not changed as a result of resecting the dorsal spinal cord or the sciatic nerve, or stripping the femoral artery. The colour disappears, however, if all the soft parts are cut or if the skin is resected. The granules are not composed of guanine. G. M. F.

Embryology, etc.

The Chromosomes of Fowls and Turkeys.—P. J. SHIWAGO ("Sur les garnitures chromosomales des poules et des dindes," *Compt. rend. Acad. des Sci.*, 1929, **188**, 513–15). In both the male and female fowl there are 32 chromosomes varying

from 0.5μ to elongated elements 6μ in length. In the male all the elements are paired both in somatic and sperm cells. In the female one of the chromosomes of the longest pair (ZZ) is replaced by an extremely minute dot (W). The cytologic schema for the fowl is thus ZW-ZZ. The turkey has a similar schema, but there are altogether 46 chromosomes, the seven additional pairs being small. G. M. F.

Parasitism and Taxonomy, Geographical Distribution and Paleogeography.—M. M. METCALF ("Parasites and the Aid They Give in Problems of Taxonomy, Geographical Distribution and Paleogeography," *Smithsonian Misc. Collections*, 1929, 81, no. 8, 1-36, 4 text-figs.). A review is given of the bearing of host-parasite data on taxonomic, geographic and paleogeographic problems. An instance of the use of this host-parasite data may be taken from the Leptodactylidæ which take the place of the true frogs in South America, Australia, Tasmania, Papua and adjacent islands. This widely scattered distribution might be due to dispersal by means of a southern land connection between Australia and South America, to parallel evolution, or to origin and radiation from some northern centre. In the recta of Australian and South American Leptodactylidæ there occurs a characteristic ciliate protozoan, *Zelleriella*, which is restricted to Australia and in the New World to South America and the Gulf Coast of the United States, where the toads (*Bufo*), the tree-frogs (*Hylidæ*), and some ranids have adopted it. Parallel evolution of the Leptodactylidæ would necessitate parallel evolution of *Zelleriella* unless there is postulated the existence of a former land connection between South America and Australia by way of an antarctic continent.

G. M. F.

Intestinal Length.—OSCAR RIDDLE and FLORENCE FLEMION ("A Sex Difference in Intestinal Length and its Relation to Pituitary Size," *Endocrinology*, 1928, 12, 203). Female ringdoves have longer intestines (5 to 10 p.c.) than the males. The presence of ascaridia is associated in both sexes with longer intestines. The view that the female pigeon has the larger pituitary is confirmed. The evidence now shows that in rats and birds the female pituitary and the intestine are larger than the corresponding male organ. Some biological and clinical results of this conclusion are suggested.

A. S. P.

Growth of the Seminal Vesicles.—OSCAR RIDDLE ("The Cyclic Growth of the Vesicula seminalis in Birds is Hormone Controlled," *Anat. Rec.*, 1927, 37, 1). In two feral birds (the oven bird and the wood thrush) a cyclic development of the vesiculæ seminales is found. This cyclic enlargement, amounting to at least 20 times the normal, cannot be ascribed to the presence of spermatozoa. The growth is almost certainly dependent upon cyclic increment of the testis. The author compares the cyclic development of the seminal vesicles with that of the oviduct at ovulation, and with the growth of the uterus during pregnancy.

A. S. P.

Growth of the Gonads and Bursa Fabricii in Birds.—OSCAR RIDDLE ("Studies on the Physiology of Reproduction in Birds. XXIII. Growth of the gonads and bursa Fabricii in Doves and Pigeons, with Data for Body Growth and Age at Maturity," *Amer. Jour. Phys.*, 1928, 86, 248). In both pigeons and ringdoves the bursa Fabricii attains the maximum size at about three months old. This period, during which growth is rapid, coincides with rapid growth in the body and thymus and with very slow growth in the gonads. The bursa begins its involution as soon as maximum size is attained, and synchronously the thymus begins its involution, and the gonads the rapid growth phase. It is therefore

concluded (a) that the bursa has an endocrine function, (b) that it is closely related to the thymus, and (c) that these two organs have an identical function.

A. S. P.

Extirpation of the Bursa Fabricii.—OSCAR RIDDLE and MASAHARU TANGE ("Studies on the Physiology of Reproduction in Birds. XXIV. On the Extirpation of the bursa Fabricii in Young Doves," *Amer. Jour. Phys.*, 1928, 86, 666). Removal of the bursa Fabricii soon after hatching does not affect the rate of growth, the adult body weight, or the age of sexual maturity. These results would follow if the bursa had no function whatever, but the authors consider that the thymus replaces the functions of the bursa.

A. S. P.

Spermatogenesis in Belostomatidae.—ARTHUR M. CHICKERING ("Spermatogenesis in the Belostomatidae. II. The Chromosomes and Cytoplasmic Inclusions in the Male Germ Cells of *Belostoma flumineum* Say, *Lethocerus americanus* Leidy, and *Benacus griseus* Say," *Jour. Morph. and Physiol.*, 1927, 44, 541). The diploid number of chromosomes is 28 in *Benacus griseus*, 24 in *Belostoma flumineum*, and 8 in *Lethocerus americanus*. All three species possess an XY pair. All spermatogonial divisions are equational and, except for the X- and Y- chromosomes in *Benacus*, all chromosomes behave in a similar manner. In each of the three species the chromosomes come over from the last spermatogonial mitosis into the primary spermatocytes as leptotene threads without a prochromosome stage. Also in these species the leptotene nuclei go over into a marked synizesis stage, which is also regarded as the stage of synapsis. Chondriosomes are present in all spermatogonia as minute spherical granules. During the resting period they are massed by the nuclear membrane; during mitosis they scatter through the cytoplasm; during the early growth period they become threads; in the two maturation divisions they are arranged in a palisade around the mitotic spindle. No idiosome is observable. Golgi bodies are present in all stages, but the centrioli can only be seen in certain phases. A mitosome is also present in certain stages only.

A. S. P.

Mollusca.

Egg Laying and Birth of Young in Three Species of Viviparidae.—E. D. CRABB (*Nautilus*, 1929, 42, 125-8). *Viviparus contectoides* is believed to extrude its young enclosed in an egg membrane containing albuminous fluid. It requires from a few minutes to three hours for the young snail to hatch after the egg has been extruded. This membrane does not normally envelop the young of *Campelona decisum* and *V. malleatus* at birth. The young of this last species is probably free from the egg membrane some time before it is extruded. G. M. F.

The Anatomy of the Mollusc *Helisoma corpulenta*.—F. C. BAKER ("Certain Anatomical Features of the Freshwater Mollusc *Helisoma corpulenta* Say," *Trans. Am. Micr. Soc.*, 1929, 48, 44-7, 1 pl.). Although *Planorbis corpulentus* was described more than a hundred years ago by Say, it was long believed to be only a form of *Planorbis trivolvis* (*Helisoma trivolvis*). It is here shown that while the female genitalia of *H. corpulenta* are similar to those of *H. trivolvis* and *H. truncata*, the penis is entirely different. The radula formula is 28-1-28, with nine laterals and over eighty rows of teeth.

G. M. F.

The Eggs of *Vittrina major*.—A. E. BOYCOTT (" *Vittrina major* in Gloucester East and its Eggs," *J. Conchol.*, 1929, 18, 274). *Vittrina major* captured in Gloucestershire laid eggs in captivity measuring 1.35 mm. long and 1.07 mm. wide. This finding is entirely discrepant with Moquin-Tandon's statement that the eggs are only 0.33 mm. in diameter.

G. M. F.

A New Species of *Drymaeus*.—S. G. FINCH ("Description of *Drymaeus winilei* n. sp. from Ecuador," *J. Conchol.*, 1929, 18, 275, 1 pl.). The new species may be distinguished from *D. castus* Pfr. by its more slender appearance, more solid shell, and by the absence of the spiral striæ, so conspicuous under a lens in *castus* and *subsiliaris*. G. M. F.

On the Reproductive Processes and Development of *Pila globosa* (Swainson). Part I. Copulation and Oviposition.—K. N. BAHL (*Mem. Ind. Mus.*, 1928, 9, 12, 2 pls.). According to modern practice, *Pila* is a name which conceals the better-known title of Ampullaria. Prashad, in 1925, stated that he knew of only one account of the oviposition of Ampullaria, which he quotes. The present author has investigated the matter, and gives a very full and interesting account of the copulation and oviposition. He used electrocution as a method of obtaining his specimens *in situ* for detailed examination. There is no incubation, as previously reported. The foot acts as an ovipositor. E. W. B.

Revision of the Asiatic Species of the genus *Corbicula*.—B. PRASHAD. (*Mem. Ind. Mus.*, 1928-9, 13-68, 6 pls.). Dr. Prashad has examined the materials and types in the great museums of the world for this investigation, and he seems to have overlooked no reference of importance. The figures are worthy of special notice, as they are all life-size photographs: we could want nothing better for illustrating the exterior of the shells. Convincing specific distinctions are rare in this group of forms. One might be inclined to suspect that the width of the ridges on the shell was a matter of importance; but if this is the case, there must be a large number of species at Basra, and that does not appear likely. The thickness of the shell is often mentioned as a character; but in all groups of mollusca this varies indefinitely. Some forms are nearly round, while others are oval or three-cornered; but the heads of dogs vary much more in shape. The colour of the nacre varies, but it is not easy to think of this as a specific distinction. The monographer's task has therefore been one of extreme difficulty, since he has to deal adequately with the claims of a large number of forms to be recognised as species, of which perhaps the majority have never been characterised satisfactorily. In such cases it must always be remembered that it is quite likely that the old conchologist detected important differences which he afterwards forgot to include in his description—it is only too easy to do so—but this means that the monographer must search the world for the original specimens to find out what it was that the describers forgot to mention, and, having done so, he must make his re-examinations with a skill and knowledge which very few people can ever possess. Dr. Prashad has done his work well. E. W. B.

The Aquatic and Amphibious Molluscs of the Northern Shan States, Burmah.—H. S. RAO (*Rec. Ind. Mus.*, 1928, 30, 69, map, 2 pls., 28 text-figs.). This is the record of results from an expedition occupying three months. It was occasioned by a report of schistosomiasis, but the suspected parasites were not found. The country should, however, be searched at all seasons. The species found were Indian and Burmese, with two Chinese forms. The drawings are very good. E. W. B.

Studies on West Indian Molluscs: the genus *Zachrysia*.—H. A. PILSBRY (*Proc. Acad. Nat. Sci., Phila.*, 1928, 80, 581-606, 3 pls., 19 text-figs.). Little has been published on the golden snails of Cuba for many years. From recent collectings, partly by himself, Pilsbry is now able to give an account of the anatomy, and incidentally to justify the generic name given by him (as a group name) in 1894. The genus differs from all of the pleurodont helices in the following particulars: (1) The right ocular retractor passes to

the left of the genitalia, not between penis and oviduct, as in most helices; (2) the spermathecal duct and oviduct are separate throughout, opening into the atrium by orifices some distance apart; (3) the epiphallus is very short; (4) the flagellum is blunt at the end and is relatively thick; (5) the spermathecal duct is short, bearing a large spermatheca, varying from as long as the duct to about half that length; (6) in the polished embryonic shell of $1\frac{1}{4}$ whorls the first half whorl has faint microscopic spiral lines, the next whorl regular costulæ radiating from the suture, or all sculpture may be nearly obsolete, as in a few species. Most species have an accessory flagellum and a sarcobelum. A warning is given as to the variations in size of different organs, which has sometimes been disregarded in descriptions and discussions. Pilsbry measures from alcoholic specimens which have not been too rapidly dehydrated. About twenty forms are known, which are here discussed so far as the material permitted.

E. W. B.

Land Shells of Tortuga Island, Haiti, and a New Haitian Oleacina.—H. A. PILSBRY and E. G. VANATTA ("Review of the Species of *Lucidella* belonging to the sub-genus *Pœniella* (Helicinidæ) of Haiti and San Domingo," *Proc. Acad. Nat. Sci., Phila.*, 1928, 80, 475–82, 1 pl.). Descriptions and figures of six new forms.

E. W. B.

Notes on the Quantitative Distribution of Molluscs and Polychætes in Certain Intertidal Areas on the Scottish Coast.—A. C. STEPHEN (*Proc. Roy. Phys. Soc., Edin.*, 1929, 21, 205–16). The method employed in making the collections has been to mark out on the sand a square of half a metre, and to dig this to a depth of 15 cm., sorting through a sieve with circular holes 2 mm. in diameter. Tables are given showing the distribution of the various forms found. On sandy ground *Tellina tenuis* was most abundant; in muddy ground *Cardium edule* predominated.

E. W. B.

Notes on the Biology of *Tellina tenuis* da Costa.—A. C. STEPHEN (*Journal of Marine Biol. Assoc.*, 1928, 15, no. 2, 1 fig., 4 graphs). Kames Bay having been found very rich in *Tellina tenuis*, samples were taken from eight fixed stations on six occasions during a complete year, and parallel observations were made in six other areas in the neighbourhood. The methods of sampling are described. Larger specimens and more rapid growth are observed at the higher levels. The population seems to be composed of four-year groups, one of which is present in very small numbers.

E. W. B.

The Marine Biological Association.—The Journal issued November, 1928, contains an account of the foundation and history of the Association, with an illustrated description of the Plymouth laboratory and its fleet. This is followed by an imposing list of publications carried on under the auspices of the Association from 1886 to 1927. Curiously enough, the only entry under Microscopic Technique is a note printed in *J. Roy. Micr. Soc.* for 1927, p. 335.

E. W. B.

Arthropoda.

Insecta.

Malayan Blattidæ.—M. HEBARD ("Studies on Malayan *Blattidæ* (Orthoptera), *Proc. Acad. Nat. Sci., Philadelphia*, 1929, 81, 1–109, 6 pls.). In past years small collections of *Blattidæ* were sent to the author for determination from the Malay Peninsula by J. C. Moulton, and from Sumatra by E. Jacobson. In addition, occasional Malayan specimens have been received from other sources, and by exchange with the Geneva Museum Javanese material of several species has been

obtained, which was determined, but never reported, by H. de Saussure. The author has felt the necessity of fulfilling his obligations as to the two series first mentioned above, but hoped that additional series from the same sources would give a more comprehensive knowledge of the cockroaches of those regions. It seems probable that additions may not be secured for a long time, and he has therefore decided to undertake the task without further delay. Nothing approaching a general survey of the Malayan *Blattidæ* has been found possible, but material aid in the study of the species represented has been obtained through possession of large Blattid collections from both India and the Philippine Islands. In the present study vigorous efforts have been made to locate the genotypes of the older genera which are or might be found in Malaysia, and in a number of cases this has met with success. In the sections where an exceptional number of new genera have been found, keys have been supplied to facilitate recognition of the genera there associated. 439 specimens, representing 55 genera and 100 species, have been examined. Of these, 19 genera and 24 species are described as new. M. E. M.

Mosquitoes and Dengue Fever.—G. BLANC and J. CAMINO-PETROS ("Durée de conservation du virus de la dengue chez les *Stégomyas*. L'influence de la saison froide sur le pouvoir infectant," *Compt. rend. de l'Acad. des Sci.*, 1929, 188, 1273-5). In Greece the virus of dengue is transmitted solely by *Aedes argenteus* (*Stegomyia fasciata*). The mosquitoes become infective nine days after feeding on an infected person. Such infected stegomyia can remain alive for at least 200 days, and can transmit the infection for at least 174 days, from one year to another. So long as the temperature remains above 18° C., the mosquitoes remain infective, but below 18° C. they cannot transmit the virus, which, however, is not killed by the process of cooling. G. M. F.

Regional List of New Zealand Tipuloidea.—C. P. ALEXANDER ("Tipuloidea of the Tongariro National Park and Ohakune District, New Zealand," *Philippine Journ. Sci.*, 1929, 38, no. 2, 157-97, 1 text-fig.). The detailed knowledge of the crane-flies of the immediate vicinity of Ohakune and Mount Ruapehu, Wellington Province, New Zealand, that has now become available through the efforts of Mr. Thomas R. Harris and a few other collectors, warrants the publication of a list of the species. To this the author adds numerous biological notes on some of the species, and includes descriptions of the geographical limits adopted in the present report, the physical geography, climate, and vegetation of the localities, and the seasonal distribution of the species. M. E. M.

North American Meloidæ.—E. C. VAN DYKE ("A Reclassification of the Genera of North American *Meloidæ* (Coleoptera), and a Revision of the Genera and Species formerly placed in the Tribe *Meloini*, found in America north of Mexico, together with Descriptions of New Species," *Univ. Calif. Publ. Ento.*, 1928, 4, no. 12, 395-474, pls. 15-19). The *Meloidæ*, or family of Blister Beetles, is one of the larger families of heteromorous Coleoptera, and one of the most compact and distinctly isolated, biologically as well as morphologically. Its members are to be found throughout the warmer and temperate parts of the world, though they are but poorly represented in Australia and the south temperate regions generally, in spite of the fact that the family is probably a very old one. It is well represented in North America, and, as a result, has claimed the attention of many workers. The last complete revision of the North American species of the family was that of Le Conte (1853). Later revisions of the genera were made by Horn (1868), Le Conte and Horn (1883), and Wellman (1910), and were useful in better defining the genere and in amplifying the tables so as to receive the species later

made known. The accepted classification, however, was not perfectly satisfactory to the critical worker, and Horn (1894) went so far as to state that one of the tribes, the *Meloini*, as at present constituted, was an unnatural group wherein had been placed a miscellaneous assembly of genera simply because they were wingless. The author's own studies of the family, which in the main have been limited to this tribe, have led him to accept Horn's views; and, in order logically to carry out this conception, he has abolished the old tribe and placed the various genera and species in a new alignment. This has, of course, made necessary the revamping of the entire family. In the present paper the author first outlines the proposed new classification for the entire family, and then discusses in detail the genera and species formerly placed in the tribe *Meloini*.
M. E. M.

Tropisms and Sense Organs of Lepidoptera.—N. E. MCINDOO ("Tropisms and Sense Organs of Lepidoptera," *Smithsonian Misc. Coll.*, 1929, 81, no. 10, 1-59, 16 text-figs.). In order to throw light on the biology of the codlin-moth, the author conducted a thorough investigation of the tropisms of this insect. Definite results were only obtained by using the larvæ. In all, 154 larvæ were individually tested in the laboratory under various conditions. In bright light, although not in direct sunshine, larvæ of the first instar were weakly photopositive. Certain tests indicated that objects are perceived and located by the senses of smell and sight, and by mere chance. Chance alone seemed to play its part in only 30 p.c. of the cases, sight and chance in 40 p.c., and smell, sight and chance combined were effective in 65 p.c. of the cases. The author's work includes studies on Phototaxis, Chemotaxis, Geotaxis, and Thigmotaxis (tactile response), the related sense organs, other receptors, and scent-producing organs. Discussing the fact that certain varieties of apples are more susceptible to codlin-moth injury than other varieties, which may be due to several factors, including thickness, toughness, and waxiness of the apple peel, etc., the author admits that a study of these factors raises more questions than it answers. Consequently, a careful study of the morphology of the sense organs of the codlin-moth was undertaken in order that some light might indirectly be thrown upon the factors concerned with selective choice.
M. E. M.

New Species of Cimex.—E. H. CORDERO and E. G. VOGELSANG ("Dos nuevas especies del género *Cimex* parasitas de aves" (Two New Species of *Cimex*, Parasites of Birds), *Cuarta Reunion de la Soc. argentina*, 1928, 671-6, 4 text-figs.). Descriptions and illustrations of the following species are given: *Cimex furnarii* sp. nov., *Cimex passerinus* sp. nov.
M. E. M.

A New Species of Phlebotomus.—E. H. CORDERO, E. G. VOGELSANG, and V. COSSIO ("Phlebotomus gaminarai sp. nov., a New Species of Phlebotomus from Uruguay" (in Spanish), *Cuarta Reunion de la Soc. argentina*, 1927, 649-52, 2 text-figs.). A description, with relative measurements of the anatomy and figures of *Phlebotomus (Lutziomyia) gaminarai* sp. nov., is given in this paper.
M. E. M.

Hemiptera of Hertfordshire.—E. A. BUTLER and RAY PALMER ("List of Hemiptera Recorded in Hertfordshire," *Trans. Herts. Nat. Hist. Soc.*, 1929, 18, pt. 4, 206-11). The list is based on information given to the associated author by the late Mr. E. A. Butler, to which certain notes and additions have been made subsequently. The list includes 192 species of Heteroptera, but only 42 records of Homoptera are available. Butler's list and records date from 1880 to 1919.
M. E. M.

Hymenoptera aculeata in Hertfordshire.—RAY PALMER ("Additional Records of *Hymenoptera aculeata* in Hertfordshire for 1926-1928," *Trans. Herts. Nat. Hist. Soc.*, 1929, 18, pt. 4, 224-6). The list includes 25 additions to the county list, making a total of 143. M. E. M.

Arthropoda.

Arachnida.

Tasmanian Spiders.—V. V. HICKMAN ("Studies in Tasmanian Spiders, Part III," *Papers and Proc. Roy. Soc. Tasmania* for 1928, 1929, 96-118, 3 pls., 9 text-figs.). Descriptions are given of the following species: Fam. *Aviculariidae*, sub-fam. *Miginae*, gen. *Migas*, *Migas nitens* Hickman; fam. *Dyseridae*, sub-fam. *Segestrinae*, gen. *Ariadna*, *Ariadna major* sp. nov.; fam. *Mimetidae*, gen. *Mimetus*, *Mimetus audax* sp. nov.; genus *Ero*, *Ero tasmaniensis* sp. nov. The author gives an account of the habits of a male *Migas nitens* Hickman which was kept in captivity for a period of two and a half years. In the earlier Proceedings of the Society the author gave a brief description of the nest of *Hexathele montanus* from the Western Tiers. Since then he has examined a large number of these nests on the Cradle Mountains, and is able to make the following additional observations: "The spider seems to be the most common Avicularid on the Cradle Mountains, and is very plentiful in the vicinity of Daisy Dell. It makes its nest under the bark of trees, in rotten logs, in stumps, and sometimes under stones on the ground. The nest is made by lining some natural cavity with silk, and in most cases the opening of the nest is expanded into a thick silken network. During the daytime the entrance is closed with a few threads of silk woven across the opening. One nest which was examined contained a pear-shaped egg-sac hung from the silk-lined cavity."

M. E. M.

Portuguese Spiders.—A. BACELAR ("Aracnídeos portugueses," *Bull. de la Soc. portugaise des Sciences naturelles*, 1928, 10, no. 17, 169-203). This is the third part of the study by the same author, and consists of a catalogue of the genera and species recorded from Portugal. The list includes 417 species. A short bibliography accompanies the paper, and the names of the species are arranged alphabetically in an attached index. M. E. M.

Spiders from the Congo.—R. DE LESSERT ("Araignées du Congo recueillies au cours de l'expédition organisée par l'American Museum (1909-1915)," *Revue Suisse de Zoologie*, 1929, 36, fasc. 1, nos. 1-4, 103-59, 29 text-figs.). This is the third part of the present paper, and deals with the family *Gnaphosidae*. Thirty-six species are described, of which 16 are new. M. E. M.

Spiders from Panama.—NATHAN BANKS ("Spiders from Panama," *Bull. of Mus. of Comp. Zool., Harvard*, 1929, 69, no. 3, 53-96, 4 pls.). The collections were made from about the middle of June to the middle of August in 1924, from the island of Barro Colorado, the vicinity of Panama City, and points along the Panama railroad. Thus all the collecting was done in the low land of the country. The island of Barro Colorado presents primitive forest conditions, while elsewhere collecting was in more open country. From the evidence of the spiders collected, it is plain that the fauna is closely related to that of South America rather than to that of the general Central American fauna. Dr. Petrunkevitch, with material from higher regions of Panama, reached the opposite conclusions. The affinity with South America is especially distinct when viewing the spiders of Barro Colorado. A number of South American spiders was found here which were unknown or

rare in Central America. One of the most common Acrosomas was *A. schreibersi*, a species common in South America, but previously noted from Central America only in one coast locality. It is also evident that the Pacific side shows the greater relation to the Central American fauna, while the Atlantic side contained the greater number of South American forms. There are often differences in localities only a few miles apart. For example, on Barro Colorado one of the most common Leucage was *L. mandibulata*, not found elsewhere, while across the lake at Frijoles the common Leucage was *L. argyra*, not found on Barro Colorado, but taken elsewhere along the canal. The author has included in his list a few species taken by Dr. Wheeler on a previous trip and some obtained by Dr. Barbour, some received from Mr. Shropshire and a few from other collectors. Altogether in this list there are 241 species of 26 families, 30 species being regarded as new. M. E. M.

Revision of the Indian Ixodidae.—M. SHARIF ("A Revision of the Indian Ixodidae, with Special Reference to the Collection in the Indian Museum," *Rec. Ind. Mus.*, 1928, 30, pt. iii, 217–344, 2 pls., 49 text-figs.). The importance of ticks as disease carriers in man and domesticated animals has made their study very popular with parasitologists in other countries, but in India they have, so far, not received the attention they deserve. The tick fauna of India is very rich in number of both genera and species, but most of the Indian species are poorly described and insufficiently illustrated. The only up-to-date account of ticks is that of Nuttall, Warburton, Robinson, and Cooper (1908–1926); but this work is still incomplete, and the descriptions of many of the Indian forms are far from adequate. In this paper the author has attempted to amplify the descriptions of the Indian species that have been dealt with by the authors mentioned above, and has redescribed other forms which occur in India, but have not been dealt with by these prior authors. Some of the rarer Indian species described or recorded by previous workers—which the present author has had no opportunity of examining—are not considered in detail, but are only included in the analytical keys of the species. Most of the collections dealt with in this paper belong to the Zoological Survey of India (Indian Museum), Calcutta. In almost all cases analytical keys are given to facilitate the identification of the Indian genera and species. A bibliography at the end of the paper includes only those references which are not included in the two volumes of the bibliography of the *Ixodidae* by Nuttall, Cooper and Robinson (1911, 1915). In the account of the geographical distribution of the various species the author gives the general range of their distribution, and also gives a detailed list of localities from which they have been recorded in India. The life-history and bionomics of most of the Indian species are as yet unknown.

M. E. M.

American Oribatid Mites.—A. P. JACOT ("American Oribatid Mites of the Sub-family *Galumninae*," *Bull. Mus. Comp. Zool., Harvard Coll.*, 1929, 69, no. 1, 3–37, 6 pls.). The species of this group have heretofore been placed under generic names in a rather arbitrary manner and with no apparent concept of the phylogenetic relationships. The author discusses the relation of the genera, and proposes a system of reclassification based on his own observations and the observations of other workers. A description of the Eastern American representatives of the genera *Parakalumma* and *Neoribates* is given, and also a description of the only other species of *Parakalumma* known to the author, i.e. the genotype. A study of the material at hand, representing the genera *Zetes* and *Galumma*, necessitates the description of several new species here given. Diagnoses of these species are presented, pending a detailed report now in course of preparation covering all known species from the United States of America.

M. E. M.

Cestoda.

A New Tapeworm from a Stickleback.—E. C. HOFF and H. E. HOFF ("Proteocephalus pugetensis, a New Tapeworm from a Stickleback," *Trans. Am. Micr. Soc.*, 1929, 48, 54-61, 1 pl.). *Proteocephalus pugetensis* sp. nov. is a small cestode, 0.25 mm. in length. It has a fifth rudimentary sucker, small functional suckers, and a few testes arranged in one layer. G. M. F.

New Sources of Broad Tapeworm Infestations.—TEUNIS VERGEER (*Journ. Am. Med. Assoc.*, 1928, 91, 396-7). Since the report of the finding of plerocercoids of *Diphyllbothrium latum* in fish from Lake Winnipeg, they have been found in wall-eyes (*Stizostedion vibreum*) and pickerel (*Esox lucius*) from most of the important Canadian lakes, from Lesser Slave Lake, Lake Manitoba, Lac la Biche (Alberta), and Lake of the Woods. In 104 fish examined, 15 plerocercoids were obtained. Three new human cases had been noticed during the last month, one of which is reported, bringing the total up to 14. Six of these were of Jewish parentage, and 13 were under 11 years old. Twenty-five specimens of wall-eyes from Lake Nipigon recently contained in all 53 plerocercoids, and 147 were taken from 4 pickerel from the same lake. J. L.

Canadian Fish a Source of the Broad Tapeworm of Man in the United States.—TEUNIS VERGEER (*Journ. Am. Med. Assoc.*, 1928, 90, 1687-8). Nearly 80 p.c. of all wall-eyes consumed in the United States are imported from Canada. In a shipment of 27 wall-eyes taken from Lake Winnipeg 5 plerocercoids were found. Four of these were fed to a dog, from which later four *Diphyllbothrium latum* were recovered. One plerocercoid similarly obtained from a shipment of 20 wall-eyes, from the same lake, also gave rise to a mature *D. latum* in a dog. Thus it is thought that the eating of fish from Lake Winnipeg may be responsible for a large percentage of the cases of *D. latum* infestation in the United States outside the endemic areas. The author suggests that fish in many of the Canadian lakes will be found to be infected, as many of the settlers around these lakes are immigrants from Baltic countries. J. L.

Trematoda.

A Lung Fluke from *Rana clamitans*.—M. S. IRWIN ("A New Lung Fluke from *Rana clamitans* Latreille," *Trans. Am. Micr. Soc.*, 1929, 48, 74-9, 1 pl.). *Pneumonoeces* is one of a small number of genera of flukes found in the lungs of anurans. A new species, *P. parviflexus*, is here described and figured. It most clearly resembles *P. breviplexus*. G. M. F.

The Trematode Family Strigeidae.—R. CHESTER HUGHES ("Studies on the Trematode Family Strigeidae (Holostomidae), No. XVIII. *Tetracotyle serpentis*, sp. nov.," *Trans. Am. Micr. Soc.*, 1929, 48, 12-19). An apparently new species of strigeid metacercaria, *Tetracotyle serpentis*, is described and figured. It was found encysted in specimens of *Thamnophis sirtalis sirtalis* (Linné) taken in the vicinity of Douglas Lake, Cheboygan County, Michigan. The new species closely resembles *T. pipientis*, with which it may be identical. A list of the species of tetracotyles which have been found in vertebrates other than fishes is appended. G. M. F.

The Phyllodistomes of North America.—F. H. HOLL (*Trans. Am. Micr. Soc.*, 1929, 48, 48-53, 1 pl.). The genus *Phyllodistomum* contains trematodes parasitic in the urinary bladders of fishes and amphibians. Two new species of this genus are described in freshwater fishes in North Carolina, *P. pearsei* sp. nov.,

from the urinary bladder of the blue-spotted sunfish, *Enneacanthus gloriosus* (Holbrook), and *P. carolini* sp. nov., from the urinary bladder of the yellow bull-head, *Ameriurus natalis* Le Sueur. G. M. F.

On Some Trematodes with Anus.—Y. OZAKI (*Jap. Journ. Zool.*, 1928, 2, 5-33). Two new genera are added to the *Opeacelidæ*, *Opegaster* and *Anisoporus*. A third new genus, *Diploporus*, is placed in a new family, the *Diploproctodæidæ*, and is characterised by having two ani, each gut branch opening separately at the posterior end of the body. Of the ten species described, eight are new to science, and these are illustrated. J. L.

Some Gasterostomatous Trematodes of Japan.—Y. OZAKI (*Jap. Journ. Zool.*, 1928, 2, 35-60). The eight species described and illustrated belong to the genera *Proisorhynchus*, *Gotonius*, *Dolichoenterum*, *Nannoenterum*, and *Bucephalopsis*. The three species of *Bucephalopsis* are new. J. L.

Studies on the Trematode Family Strigeidæ (Holostomidæ). No. 9. Neascus van-cleavei (Agersborg).—R. CHESTER HUGHES (*Trans. Am. Micr. Soc.*, 1928, 47, 320-41, 3 pls.). The paper gives a morphological account and a discussion of the literature on this species, which is closely allied to the *N. cuticola* (von Nordman) of Europe. The material, which was examined both fresh and preserved, was obtained mainly from the liver of *Eupomotis gibbosus*, *Xenotis megalotis pelbastes* Cope, and *Ambloplites ruspectris* (Raf.), from the Huron river, and from some heavily infected specimens of *Helioperea incisor* Cuv. and Val., where the cysts were found mainly in liver, but also in mesenteries and heart, as well as from other fish. In conclusion, a comparative synopsis of the described *Neascus* larvae is given. J. L.

Notes on Trematode Parasites of Birds.—E. LINTON (*Proc. U.S. Nat. Mus.*, 1928, 73, 1-36, 11 pls.). With two exceptions, the hosts from which these trematodes were obtained were collected in the Wood's Hole, Mass., region, and the examination of both living and preserved material was made at the laboratory of the U.S. Bureau of Fisheries there. The 22 species which are described and figured include 1 new genus, *Minuthorchis*, and 10 new species. In many cases detailed records of collection accompany the descriptions. J. L.

Some Trematodes Parasitic on the Gills of Victorian Fishes.—WINIFRED KENT HUGHES (*Proc. Roy. Soc. Victoria*, 1928, 41 (N.S.), 45-54, 4 pls.). The specimens were fixed in 1 p.c. formalin. Whole specimens were stained with Ehrlich's hæmatoxylin, and sections with iron hæmatoxylin. Five new species and one new genus, *Macrophylla*, are described. The latter resembles *Tristomum*, but can be distinguished from it by having only two compact testes, five instead of seven distinct radii in the posterior sucker, and glandular membranes at the anterior end in the place of suckers. J. L.

Brief Notes on New Trematodes.—S. GOTO and Y. OZAKI (*Jap. Journ. Zool.*, 1929, 2, 213-17). Three new species are described: *Mesocælum brevicæcum* from the intestines of *Bufo vulgaris formosus*, *Mesocælum elongatum* from *Diemyetylus pyrrhogaster*, and *Mesocælum lanceatum* from *Tylotriton andersoni*. J. L.

Two New Trematodes of the genus Platynosomum.—E. G. VOGELSANG and E. H. CORDERO ("Dos nuevos trematodes del genero *Platynosomum*," *Cuarta Reunión de la Soc. argentina de Patología regional del norte*, 1928). A description of

P. mazzai, two specimens of which were obtained from the gall-bladder of *Speotylo cunicularia* Mol., and *P. furnarii* from the gall-bladder of *Furnarius rufus* Gm. Each of the bird hosts was caught in the neighbourhood of Montevideo. J. L.

***Distomium xenodontus* n. sp.**—E. H. CORDERO and E. G. VOGELSANG (*Cuarta Reunión de la Soc. argentina de Patología regional del norte*, 1928). Among other helminths recovered from the intestine of *xenodon merrémi* (Wayler) were 125 specimens of a new species of trematode, *Distomum xenodontis*. The specimens were examined both by means of stained toto mounts and also by sections. The new species is described and illustrated, and the paper concludes with a short note on the systematic position. J. L.

Nematoda

The Larva of the Nematode *Spirocerca sanguinolenta*.—E. C. FAUST ("The Egg and First-Stage (Rhabditiform) Larva of the Nematode *Spirocerca sanguinolenta*," *Trans. Am. Micr. Soc.*, 1929, 48, 62-5, 1 pl.). The adult *Spirocerca sanguinolenta* is usually found in tumour-like nodules in the wall of the digestive tract of dogs, more especially in the œsophagus. The eggs are elongatedly oval in shape, with parallel sides and bluntly rounded ends. They are opalescent and whitish in colour, 22-27 μ by 8-12 μ . The mature larva within the egg-shell is somewhat modified from the rhabditiform type, the anterior end being bluntly conoidal, the middle half of the body fleshy, while the tail is tapering. The larva free from the egg has six labia symmetrically arranged around the oval aperture, while on the dorsum of the head there is a pattern of blunt flat scales. The larva is about 120 μ long, and has a greatest transverse diameter of 20 μ some 50 μ from the anterior end. G. M. F.

On the Anatomy of the Nematode *Passalurus ambiguus* (Rudolphi).—B. L. DANHEIM and J. E. ACKERT (*Trans. Am. Micr. Soc.*, 1929, 48, 80-5, 1 pl.). Detailed drawings of the structure of the head and of the annular portion of the female tail are here presented for the first time. Four cephalic papillæ and twelve symmetrically arranged muscle plates extending posteriorly from the head are so prominent as to merit inclusion among the distinguishing characteristics of the species. G. M. F.

The Third-Stage Larva of *Ancylostoma caninum* and *Ancylostoma ceylanicum*.—EOLLE EISMA (*Tijdschrift der Nederlandsche Dierkundige Vereeniging*, 3rd ser., 1, 72-6). The material, which was obtained from cats and dogs infected with *Ancylostoma caninum* and *A. ceylanicum*, was cultured by the plate and funnel method. It was found that two types of third-stage larva could be distinguished, the one having a short blunt tail and the other a long pointed one. Some of the cats were then killed, and, after identification of two species of adults present, pure cultures were made from their eggs. The third-stage larvæ of *A. caninum* was found to have short obtuse tails, while those of *A. ceylanicum* were long and pointed, corresponding exactly with those found in the mixed cultures. Thus the length of tail of the infective larvæ, measured on the sheath, could be used as a method of differentiating the species. The head, which was examined by a special technique, possessed three lips, each bearing two papillæ. J. L.

Studies on Hookworm. *Ascaris* and *Trichuris* in Panama.—W. W. CORT and OTHERS (*Am. Journ. Hyg. Mono.*, 1929, ser. no. 9, 1-215). This report embodies the results of the researches of an expedition to the Republic of Panama sent from the Department of Helminthology of the School of Hygiene and Public

Health of the Johns Hopkins University in 1926. The studies open with a brief description of the geography and people of Panama, and of the hookworm campaign from 1914-1926. During the latter a hookworm incidence of 86 p.c. was found. In describing the egg-counting technique used, attention is drawn to the comparative inefficiency of the Willie technique in diagnosing ascaris infections. In regard to egg counts as a measure of worm burdens, the effect of consistency of the stool, total daily faecal output, and variation in size of stool due to age, on the interpretation of egg count data is discussed, and the desirability of securing more information on normal stool sizes elsewhere is emphasised. The use of a standard population in the interpretation of incidence and intensity rates, in correcting data which would otherwise make no allowance for age or sex, is illustrated, and the way in which such standardisation facilitates comparisons between statistics from widely separated areas. The studies on soil pollution and soil infestation and analysis of egg counts were made in areas in Panama which had been uninfluenced by previous control measures. They showed a high level of hookworm infestation, which was 50 p.c. higher in the hills than in the plains. This difference was attributable to the heavier rainfall and denser vegetation of the hill regions. Infestation in the adult male considerably exceeded that in females, and children on the whole showed unusually high egg counts. The chief factors responsible for the high level of hookworm infestation in Panama were apparently the long rainy season, the intense soil infestation near houses produced by the soil-pollution habits of the people, and the almost universal absence of shoes in the daily occupation. A study was made of the effect of treatment and sanitation on the level of hookworm infestation in areas under partial control. In unsanitated areas comparison showed a rapid return of treated individuals to the level of untreated individuals, while in sanitated areas the effect of treatment lasted much longer. The investigation showed, however, that the effect of treatment and of building latrines in reducing the hookworm incidence was rather small, and that much remained to be done in Panama before hookworm could be brought under control. The recently adopted pre-sanitation, with emphasis on sanitary inspection, is regarded as a sound measure. It is suggested that treatment campaigns should be repeated in these partially controlled areas after sanitation has been brought up to date. Estimation of hæmoglobin as a measure of the intensity of hookworm infestation showed that people from two districts of the same country might be influenced to an entirely different degree by hookworm infestations of comparable intensity, and indicated a need for further study on the influencing factors involved. Quantitative studies on the distribution of *Ascaris lumbricoides* and *Trichuris trichiura* showed that the heaviest infections were in children, and were greater in young female adults than in males. Neither rainfall nor hookworm control measures appeared to influence dissemination, which was thought to depend mainly on the deposition of stools by young children close to houses, causing impregnation of the immediate environs of the houses and of the floors themselves. J. L.

Penetration by Infective Hookworm Larvæ of the Materials Used in the Manufacture of Shoes.—GEORGE C. PAYNE (*Am. Journ. Trop. Med.*, 1929, 9, 79-82). The testing materials were taken from a new pair of canvas shoes and from a slightly worn pair of lady's high-grade shoes of thin calf-skin. Square portions were cut out, moistened and placed in contact with the surface of a culture of *Necator americanus* of three weeks old. By this method it was found that wet canvas shoes were readily penetrated by infective hookworm larvæ, and were therefore probably of no value as a protection. Larvæ migrated freely over the surface of wet leather, although actual penetration was not witnessed. They were,

however, capable of entering any minute defect in leather stitching, so that the period during which an ordinary pair of leather shoes would give complete protection to a hard-working agricultural labourer was probably very short. J. L.

The Growth of Hookworm Larvæ on Pure Cultures of Bacteria.—

OLIVER A. MCCOY (*Science*, 1929, 69, no. 1777, 74-5). Ova of *Ancylostoma caninum*, freed from faeces and sterilised by treatment with 5 p.c. antiformin in 10 p.c. formalin, were used for the experiment. The ova, having been washed with distilled water several times, were introduced into agar cultures made up in 250 c.c. Erlenmeyer flasks which had been inoculated with bacteria 24 hours previously. Broth cultures were used as controls. It was found that larvæ reached the infective stage in the normal period of about seven days on pure cultures of *Bacillus coli*, *Bacillus subtilis*, *Bacillus prodigiosus*, *B. lactus aerogenes*, *Staphylococcus aureus*, *Spirillum metchnikovi*, *S. rubrum*, and *Micrococcus citreus*. Ova on plain agar without bacteria hatched normally and lived for 10 days, but did not grow. If bacteria were subsequently added, the larvæ reached the infective stage. Not all bacteria produced growth; but the experiments demonstrated that hookworm larvæ, in growing to the infective stage, were able to utilise bacteria as their sole source of food. J. L.

Hookworm Disease.—W. G. SMILLIE (*Nelson Loose-Leaf Medicine*, 1928, 2, 477-90G). Beginning with a definition and a general description of the disease, and with an account of its history, the author goes on to describe the parasites, their life-history, and mode of infection. Pathology, clinical aspects, and methods of treatment are then dealt with. In conclusion, general prophylactic measures are discussed. J. L.

On Strongyloides stercoralis Bavay.—J. H. SCHUURMANS STECKHOVEN (*Tijdschrift der Nederlandsche Dierkundige Vereeniging*, 3rd ser., 1, 48-9). The material was obtained from the duodenal mucus of a human patient. It was found that the head of all the larval stages possessed four circumoral papillæ and two amphids. The œsophagus appeared to be rhabditiform in all the larval stages also, though in the case of the filariform larva the three parts were less well defined, and it was, as a whole, longer in proportion to the body length. In the rhabditiform larva also the mouth cavity was wider and more cylindrical, and had thicker cuticle than that of the infective larva. While the filariform larva had a blunt tail and possessed two post-anal papillæ, these were absent in the rhabditiform larva, and the tail was finely pointed. Rhabditiform larvæ which were destined to become adults could be recognised by the larger initial size of the genital rudiment. J. L.

Stomach Worms in Sheep, and Their Control.—E. L. TAYLOR (*Journ. Ministry Agri.*, 1929, 36, no. 1, 31-8, 1 pl.). *Hæmonchus contortus*, the twisted wireworm, and *Ostertagia circumcincta*, the lesser stomach worm, occur in all parts of the world, most commonly on permanent pasture, but also on arable land where sheep are penned over the same area at short intervals. When present in large numbers they cause damage which may result in considerable economic loss. The twisted wireworm is very readily treated with a mixture of copper sulphate (blue-stone) and arsenious acid, although copper sulphate alone is capable of effecting the cure and is less dangerous to use. *Ostertagia* infections do not respond to any known treatment, and control of the lesser stomach worm must depend solely upon the arrangement of grazing in such a manner that the opportunity for lambs to

pick up infection is reduced to a minimum. As regards prevention, the importance of the following points is stressed: the avoidance of overcrowding, the placing of ewes and lambs on pasture which has been free from sheep for twelve months, the growth of root and forage crops on clean land for grazing in spring and early summer, and adequate penning to avoid straying. J. L.

Preliminary Report on Observations on the Development of Ova of Pig and Human Ascaris under Natural Conditions, and Studies of Factors Influencing Development.—FRED C. CALDWELL and ELFREDA L. CALDWELL (*Journ. Parasitol.*, 1928, 14, 254–60). Experiments were undertaken with a view to discovering reasons for the curious distribution of pig and human ascaris in the States, and to this end a study was made of the relation of types of soil, and the influence of various seasonal conditions to the development of ascaris ova. The soils used included the nine main types of sands, loams, silts, and clays. Analysis of results showed that, under otherwise equal conditions, when faeces were mixed with soil, all soils acted as equally good culture media. The second series of experiments dealt with the influence of sunlight, heat, drying and moisture. It was found that ova in pigs' faeces developed: (1) under normal temperatures, (2) under higher temperatures, and (3) under normal summer temperatures more rapidly than the human type. It was thought that this difference might be accounted for by the actual character of the faeces. Dessication was proved to be the greatest lethal factor to the development of ascaris ova. Hence forces which tended either to hasten or to retard drying were of importance in the epidemiology of ascariasis where soil pollution was present. J. L.

Precipitin Reaction with Various Tissues of Ascaris lumbricoides and Related Helminths.—GRAEME A. CANNING (*Am. Journ. Hyg.*, 1929, 9, 207–26). Experiments were made to test the immunological specificity of *Ascaris lumbricoides* tissues, which involved the production of an anti-rabbit serum against individual tissues of the worm. The tissues chosen were ova, sperm, muscle, intestine and cuticle, these being considered especially suitable on account of their being representative of individual germ layers. Cross-precipitin tests revealed that the tissues of *A. lumbricoides* were immunologically distinct, so further cross-precipitin tests were performed with homologous tissues of related helminths. The results of these tests are analysed and discussed, and from them the author is able to arrive at a number of interesting conclusions. It was hoped that such tests with distinct tissues would lead to a closer insight of the biological relationships of animals. J. L.

Some Intestinal Helminths of Chickens and Their Control.—JAMES E. ACKERT (*Proc. Third World's Poultry Congress, Ottawa, 1927, 333–6*). An examination of 1,000 chickens by the writer in Kansas showed a 49 p.c. infestation with *Ascaridea lineata* (Schneider), 66 p.c. with *Heterakis papillosa* (Block), and that 49 p.c. had one or more of the following tapeworms: *Choanotenia infundibuliformis* (Göetze), *Raillietaria cesticillis* (Molin), *R. tetragona* (Molin), *R. echinobothrida* (Mequin), and *Hymenolepis carioca* (Magal). After briefly discussing the effects of such parasitism, the author indicates methods of control. These depend upon the attacking of the intermediate host by prevention of its breeding, by conservation methods, screening, etc. In cases of direct development it is found that a temperature of 110° F. will kill eggs of *Ascaridea lineata* in soil. Another factor in control of the large round worm is the resistance of the chicken to parasitism, a resistance which increases with age. J. L.

Effects of the Nematode *Ascaridea lineata* (Schneider) on Growing Chickens.—JAMES E. ACKERT and CHESTER A. HERRICK (*Journ. Parasitol.*, 1928, 15, 1-13, 2 pls.). Symptoms were found to be most pronounced in young chickens during the first three weeks of parasitism, and, in general, chicks that survived such a parasitism for three weeks recovered. A definite resistance was acquired by the time they were three months old. The effects of parasitism were sluggishness, loss of appetite, ruffled feathers, drooping wings, loss of blood and of body weight, retarded muscular and osteological development, urates in the ureters, and increased mortality. These effects were attributable to damage of the intestinal mucosa by the parasites, loss of blood, probable bacterial infection, absorption of the worm's excretory products, and the partial inanition resulting from loss of appetite. J. L.

A New Species of the Nematode genus *Streptopharagus*.—P. A. MAPLESTONE (*Rec. Ind. Mus.*, 1929, 31, 1-5). A description of *Streptopharagus magnus*, obtained in large numbers from the stomach and intestines of *Hyllobates*, from the Calcutta Zoo. J. L.

Free-living Marine Nematodes from the Spitzbergen Expedition of F. Roemer and F. Schaudinn in 1898.—HANS A. KREIS ("Die freilebenden marinen Nematoden der Spitzbergen-Expedition von F. Roemer und F. Schaudinn im Jahre 1898," *Mitt. Zool. Mus., Berlin*, 1928, 14, 131-97, 7 pls.). The material dealt with comprised 94 specimens of 25 different genera and 34 species. Of these, 7 genera and 26 species are new, and these are described and the principal points in their anatomy illustrated in the numerous plates which follow. J. L.

On the Anatomy of the Nematode *Passalurus ambiguus* (Rudolphi). BERTHA L. DANHEIM and JAMES E. ACKERT (*Trans. Am. Micr. Soc.*, 1929, 48, 80-5, 1 pl.). The material was obtained from the proximal part of the cæcum of common wild rabbits. Sixty-seven were examined, but only 3-4 p.c. were found infected. These infections were, however, very heavy. In the description of the parasite particular attention is paid to the detailed structure of the head and of the annular portion of the female tail. G. M. F.

Protozoa.

Culture Medium for *Glaucoma*.—A. LWOFF ("Milieux de culture et d'entretien pour *Glaucoma piriformis* (Cilié)," *Compt. rend. Soc. de biol.*, 1929, 100, 635-6). The following medium allows for the growth of *Glaucoma* and its survival for as long as two months: NaCl, 0.5g.; KCl, 0.01g.; MgSO₄, 0.01g.; CaCl₂, 0.01g.; Na₂HPO₄, 0.01g.; Witte's peptone, 10g.; distilled water, 1,000 c.c. Yeast autolysed at 55° C. for from 48 hours to 5 days is also a good medium. The most useful medium for the preservation of *Glaucoma* up to 4 years without subculturing is composed of 2g. of rabbit liver in 10-12 c.c. of distilled water sterilised at 120° C. for twenty minutes. G. M. F.

The Effects of Radium on *Endamoeba* in vitro.—E. C. NASSET and C. A. KOFOLD ("The Effects of Radium and Radium in Combination with Metallic Sensitizers on *Endamoeba dysenteriae* in vitro.," *Univ. Calif. Publ. Zool.*, 1928, 31, 387-416, 2 pls., 7 text-figs.). The division rate of *Endamoeba dysenteriae* (*Entamoeba histolytica*) in vitro is stimulated from two to four times over that of controls by exposure to radium radiations. The stimulation, which lasts for not more than 24 hours after removal of the radium, is followed by a decided retardation of the division rate. When the beta rays are removed by aluminium, neither the stimulation nor subsequent retardation is so marked. Radiated cultures bear transplanting

indefinitely. Radium produces morphological changes in amoebæ in cultures. Irradiated amoebæ may increase in size, enucleation or autotomy may occur, and the nuclear chromatin may become homogeneous or disintegrated. A large amount of radium acting for a short time produces more striking morphological changes than a smaller amount acting for a longer time. The effects of radiation persist for four to six days after the removal of the radium. When exposed to sublethal dilutions of mercuric or lead chloride (1 in 50,000) in addition to radium, the amoebæ are killed. G. M. F.

Intestinal Protozoa of Monkeys.—J. F. KESSEL (*Univ. Calif. Publ. Zool.*, 1928, 31, 275–306, 2 pls.). Intestinal protozoa which are morphologically indistinguishable from *Endamoeba dysenteriae*, *Endamoeba coli*, *Endolimax nana*, *Iodamoeba bütschlii*, *Councilmania lasflei*, *Giardia lamblia*, *Trichomonas hominis*, *Chilomastix mesnili* and *Embadomonas intestinalis* found in man, were encountered in four species of monkeys belonging to the genus *Macacus*. With the exception of *Giardia* and *Councilmania*, these protozoa were all successfully cultured *in vitro* in the egg-serum medium in which the morphologically similar protozoa of man have been cultured. Excystment of *E. dysenteriae*, *E. nana*, *Iodamoeba* and of *Chilomastix* and encystment of *E. coli* and *E. dysenteriae* of the monkey were observed in culture. Monkeys were experimentally infected with *E. dysenteriae*, *E. coli*, *Iodamoeba bütschlii*, *E. nana*, *Chilomastix mesnili* and *Trichomonas hominis* of man. *E. dysenteriae* of monkeys was found to have invaded the mucosa, muscularis, submucosa and lymphatic nodules of the intestines of monkeys. Kittens were experimentally infected with *E. dysenteriae* of monkeys, both by cysts and trophozoites *per anum*, and the kittens developed symptoms similar to those developed in kittens infected with *E. dysenteriae* of man. G. M. F.

Cultivation of a Parasitic Amoeba.—N. M. SMITH and H. P. BARRET ("The Cultivation of a Parasitic Amoeba from the Cockroach," *J. Parasitol.*, 1928, 14, 272–3, 1 pl.). An amoeba from the American cockroach *Periplaneta americana* has been successfully cultivated *in vitro* on a simple medium consisting of a 1 in 20 dilution of inactivated human blood serum in 0.5 p.c. NaCl solution. Cultures have been carried on over a period of 24 months. The amoeba cultivated is apparently *E. Thomsoni*, originally described by Lucas (*Parasitol.*, 1927, 19, 223). G. M. F.

The Probable Mode of Infection of the Mucosa by Rhinosporidium.—E. H. CORDERO and E. G. VOGELSANG ("El probable modo de infección de las mucosas por Rhinosporidium," *Bol. del. Instit. de clin. quirurgica*, 1928, 4, 573–4, 2 text-figs.). The method by which the spores of *Rhinosporidium* reach the exterior is at present unknown. Evidence is here brought forward to show that the wall of the cyst full of spores ruptures into the lumen of the glands of the nasal mucosa. The spores thus reach the exterior in the nasal mucus. Incidentally, attempts to infect normal horses with the spores of *Rhinosporidium* failed. The authors believe that the equine form is the same species as that discovered in the first place in man. Cattle are also liable to the infection. G. M. F.

Parasitic Protozoa from Certain Animals of Uruguay.—E. H. CORDERO ("Protozoarios parasitos de algunos animales del Uruguay," *Bol. del. Instit. de clin. quirurgica*, 1928, 4, 586–92, 2 text-figs.). Nineteen species of parasitic protozoa are recorded, of which the following are new to science: *Cepedea brumpti*, which is found in the intestine of *Hyla raddiana* Fitz., and *Nyctotherus ampullariorum*, which lives in the terminal portion of the intestine of freshwater molluscs of the genus *Ampullaria* Lam. G. M. F.

BOTANY.

(Under the direction of A. B. RENDLE, D.Sc., F.R.S.)

GENERAL

Anatomy.

Development and Germination of the Seed of *Eleusine indica*.—MARGARET P. CUMMINS ("Development of the Integument and Germination of the Seed of *Eleusine indica*," *Bull. Jour. Bot. Club*, 1929, 56, 155-62, 7 figs.). *Eleusine indica* Gaertner is one of the few grasses in which the integument develops as a hard seed-coat while the pericarp remains as a thin loose layer. The edge of the outer integument is not caught in the stylar canal, as it is in most grasses. The integument continues on down to the micropyle and forms only a protuberance in the canal. The inner integument completely surrounds the nucellus when the embryo-sac is mature. It consists of two layers of cells. The inner and outer surfaces of the integument are cutinized or suberized; the cross-walls are mainly cellulose. The inner integument develops into a hard grooved seed-coat with the pericarp persisting only as a broken layer. Seeds of *Eleusine* will not germinate until after the seed-coat has been modified in some way. Freezing and thawing are the natural forcing agents, and different methods of scarifying the seed-coat give good results in germination. B. J. R.

Structure of Pollen Grains.—R. P. WODEHOUSE ("Pollen Grains in the Identification and Classification of Plants. II. *Barnadesia*," *Bull. Torr. Bot. Club*, 1928, 55, 449-62, 2 figs., 1 pl.). The forms of pollen grains generally serve best in distinguishing and showing relationships among the higher groupings, as families, tribes, and genera, but sometimes, as in the genus *Barnadesia* (Compositæ), they are also useful among species. The pollen grains of *Barnadesia* are approximately spherical, with three germinal apertures which generally bulge prominently and are situated in more or less conspicuous germinal furrows. In these respects they conform to the general ground plan of the Compositæ, but they differ from it in the possession on the surface of an elaborate system of ridges and lacunæ. This character, however, is shared with the two tribes Cichoriæ and Vernoniæ, but the grains of *Barnadesia* may be distinguished from these by the lack of lattice structure which is a prominent character of the ridges of the grains of the two latter groups, and also from the Cichoriæ by the possession of two or more times as many lacunæ, and the absence of spines which are characteristic of the ridges in the grains of the Cichoriæ. The peculiar structure of the pollen grains of *Barnadesia inermis* Rusby and *B. divaricata* Griseb. justifies their removal from this genus. *Barnadesia* is evidently closely related to the Vernoniæ and less closely to the Cichoriæ. *Schlectendalia* is a possible link between *Barnadesia* and *Chuquiraga*. B. J. R.

Structure of Pollen Grains.—R. P. WODEHOUSE ("Pollen Grains in the Identification and Classification of Plants. III. The Nassauvinæ," *Bull. Torr. Bot. Club*, 1929, **56**, 123–38, 1 pl.). Of the 15 genera included in the Nassauvinæ, the pollen from species of 11 genera was examined. The pollen grains are notable among the Compositæ for two well-marked characters—the absence of spines and the extreme development of the furrows. The pollen grain characters indicate that the group is rather compact and distinct from the rest of the tribe Mutisiæ. It appears that the Nassauvinæ may represent the culmination of three more or less distinct developmental tendencies, viz., the reduction of spines observed all through the Cynaræ and Mutisiæ, culminating in the entire absence of spines throughout this group; the lengthening of the furrows seen in various stages of development in the other tribes of the Mutisiæ, culminating in the grains of *Trixis*; and the definition of the furrows strongly felt in the Nassauvinæ, culminating in the marginate grains of *Jungia*. On the basis of the morphology of their pollen grains, the different genera of the Nassauvinæ appear to be closely related and represent the end of a phylogenetic line of the Mutisiæ. B. J. R.

Cytology.

Protoplasmic Inclusions.—ROBERT H. BOWEN ("Studies on the Structure of Plant Protoplasm. I. The Osmiophilic Platelets," *Zeitsch. Zellforsch. Mik. Anat.*, 1928, **6**, 689–725). Osmiophilic platelets, similar in morphology and distribution, have been demonstrated in the following tissues: the male heads of *Polytrichum commune*, *P. juniperinum* and *P. piliferum*, root-tips and growing points of *Equisetum arvense*, root-tips of *Vicia Faba*, *Pisum sativum* var. *arvense*, *Hyacinthus orientalis*, *Ricinus communis*, *Hordeum vulgare* var. *trifurcatum*, *Cucurbita pepo*, *Phaseolus vulgaris* var. *humilis*, and young sprouts of *Hordeum vulgare* var. *trifurcatum*. The methods of obtaining the material are described in detail and a full description given of the technique of osmic acid impregnation. The platelets are always suspended scattered in the hyaloplasm, and never found within the cell vacuoles. They are of disc shape, composed of osmiophilic material, the rim of the disc consisting of intensely osmiophilic substance. A large number of discs is always present in each cell, though the number per cell varies enormously. They are always of relatively small size, though size variation is displayed. During mitosis there is no orientation or division of the platelets; chance distribution results in approximately equal numbers being included in the daughter nuclei. The mode of multiplication of the platelets is not known, though fragmentation is suggested by the occasional appearance of groups of small platelets. The platelets have not been seen to undergo any changes which could be interpreted as visible evidences of any physiological function. In various ways these osmiophilic platelets resemble the Golgi bodies of many insects, viz., the methods by which they can be demonstrated, morphology, distribution, and lack of orderly arrangement in division. The differences presented are not considered important. The author's opinion is that the osmiophilic platelets in plants represent the Golgi apparatus in animals. J. L.

Protoplasmic Inclusions.—ROBERT H. BOWEN ("Studies on the Structure of Plant Protoplasm. II. The Plastidome and Pseudochondriome," *Zeitsch. Zellforsch. Mik. Anat.*, 1929, **9**, 1–65). The following conclusions are based upon the study of angiosperm root-tips, the plants selected being the same as those used in the previous study of the osmiophilic platelets. The technical methods are given in detail. In addition to the osmiophilic platelets, there are in plant cytoplasm two other distinct categories of formed bodies, viz., the plastidome

and the pseudochondriome. In undifferentiated cells the plastidome consists of distinctly elongated bodies which show great variety of shape. The pseudochondriosomes are characteristically spherical. Morphologically, then, these two categories are distinguishable from one another and from the osmiophilic platelets, which are always disc-shaped. These formed bodies also differ in their staining reactions. The multiplication of the individual pseudochondriosomes and archiplasts (individuals of the plastidome) is probably by simple fusion, and in mitosis an approximately equal distribution of each category to the daughter-cells is brought about. The archiplasts pass through a definite series of stages connected intimately with the nuclear division figure, thus differing in behaviour from the pseudochondriosomes, which are merely scattered throughout the cytoplasm. Division of individual elements is not correlated with the mitotic period. The osmiophilic platelets and pseudochondriosomes present no appearances indicating their functional significance. In meristematic cells the bodies of the plastidome show no indication of their special nature, but from these primordia various types of plastids are developed. It is considered impossible at present to draw any conclusion as to which of these categories of formed bodies in plant protoplasm represents the animal chondriome.

J. L.

Plastidome and Pseudochondriome of *Equisetum*.—R. H. BOWEN ("Notes on the Chondriosome-like Bodies in the Cytoplasm of *Equisetum*," *An. Bot.*, 1929, 43, 309-27). From a study of the root-tips and growing points of main and lateral stems of *Equisetum arvense* it is found that the cells contain chondriosome-like bodies of two distinct classes, i.e. the plastidome and the pseudochondriome. The plastidome is concerned solely with the process of plastid formation, while the pseudochondriome has no connection whatever with this operation. The elements of the plastidome of meristematic cells are termed the archiplasts. These may vary in shape, but are predominantly elongate. Chloroplasts or leucoplasts are gradually differentiated from these bodies. The elements of the pseudochondriome are typically spherical in shape and have no apparent function. Constant differences in staining capacity, morphology, structure and functional behaviour, favour the view that the plastidome and pseudochondriome are two entirely independent categories of cytoplasmic bodies. So far as morphology and function can be studied, the plastidome and pseudochondriome of the Pteridophyta are homologous respectively with those of the Spermatophyta. No evidence has yet been obtained in *Equisetum* that any of the chondriosome-like bodies are the actual homologues of the chondriosomes in animal cells.

J. L.

Structure of Protoplasm.—WILLIAM SEIFRIZ ("The Structure of Protoplasm," *Biol. Revs. and Biol. Proc. Cam. Phil. Soc.*, 1929, 4, 76-102). The author presents a comprehensive review of the work done on the structure of protoplasm from the times of the earliest students of the living substance up to the present. This includes work on the protoplasmic membrane, the nucleus, and the chromosomes. Structural units of colloidal dimensions are doubtless to be found in protoplasm, but are apparently merely manifestations of a finer structure which lies beyond. The review concludes with a consideration of this molecular hypothesis. The structural unit of a jelly is regarded as of molecular dimensions and of linear shape. The interlocking of these linear units gives to jellies their rigidity and high degree of elasticity. It is these same properties of protoplasm which closely indicate its jelly nature and suggest its structural design. The concept of an interlocking mass of amino-acid chains or slender crystalline fibres makes it possible to interpret the mechanism of some of the physiological properties of protoplasm which has not hitherto been done on any other type of system. Such

a mechanism would permit liquid jellies, such as protoplasm, to have elastic qualities and continuity in structure and yet (by sliding of the linear molecules) possess the capacity to flow. An extensive bibliography of 133 works is appended.

J. L.

Chromosome Arrangement Compared with Floating Magnets.—Y. KUWADA ("Chromosome Arrangement. I. Model Experiments with Floating Magnets and Some Theoretical Considerations on the Problem," *Mems. Coll. Sci., Kyoto Imp. Univ.*, 1929, B. 4, 199–264). The results of experiments made with floating magnets are compared with the arrangements of chromosomes in the following cases: (a) Where all the chromosomes of a group are nearly of the same size and shape; (b) where some of the chromosomes differ in size and shape from others of the same group; and (c) where the chromosome complements are those of hybrids. The experiments with floating magnets seem to show that the peculiarities in the chromosome arrangements are largely due to inequality in the magnitude of the electrical charge carried by the chromosomes. The final distribution figures are apparently determined by the size of the electrical charge which is carried. Irregular chromosome arrangements are found in fresh as well as in fixed material. The following reasons are given to account for these irregularities: The original distribution of the chromosomes in a space of three dimensions; the viscous nature of the cytoplasm, which would hinder the movement of the orientating chromosomes; the long time between the disappearance of the nuclear membrane and the completion of nuclear plate formation, rendering transitory stages in chromosome arrangement liable to frequent observation; the effect of fixatives; and the fact that more than one final arrangement (not equally stable) may be produced even with the floating magnets. A differential organisation of an electrically charged centre in the chromosomes is suggested in connection with their movement, and an attempt is made to explain the mechanism of the chromosome arrangement on such a basis.

J. L.

Chromosome Arrangement in Phaseolus and Cassia.—A. MUTO ("Chromosome Arrangement. II. The Meiotic Divisions in Pollen Mother-Cells of *Phaseolus chrysanthos* Sav. and *Cassia occidentalis* L.," *Mems. Coll. Sci., Kyoto Imp. Univ.*, 1929, B. 4, 265–71). The haploid and diploid chromosome numbers of *Phaseolus chrysanthos* are 11 and 22 respectively in all the cultivated forms examined. The haploid number for *Cassia occidentalis* is 13. In both these plants the chromosomes at the heterotypic metaphase are of nearly uniform size and shape. In 63.2 p.c. of the cases examined for *P. chrysanthos* the arrangement is 8 chromosomes in a ring and 3 inside; and in 58.8 p.c. of the cases for *C. occidentalis* the arrangement is 9 chromosomes in a ring and 4 inside. In each case the most frequently occurring form of arrangement is that which resembles the stable form of arrangement of floating magnets.

J. L.

Chromosome Arrangement in Vitis.—H. HIRAYANAGI ("Chromosome Arrangement. III. The Pollen Mother-Cells of the Vine," *Mems. Coll. Sci., Kyoto Imp. Univ.*, 1929, B. 4, 273–81). In 12 cultivated varieties of *Vitis* the haploid chromosome number is 19. The chromosomes in the metaphase of the heterotypic division of the pollen mother-cells are of nearly the same size and shape. When the chromosomes have assumed their final position in one plane on the equatorial plate, nine types of arrangement can be recognised. One type—viz., 11 chromosomes in an outer ring, 7 in an inner ring, and 1 central one—occurs in 66.6 p.c. of the cases examined; that is, the most frequently occurring arrangement resembles the stable form of arrangement of floating magnets.

J. L.

Sex-Chromosomes of *Humulus*.—H. KIHARA ("The Sex-Chromosomes of *Humulus japonicus*," *Jap. Journ. Genetics*, 1929, 4, 55–63, Japanese with English summary). The diploid chromosome numbers in *Humulus japonicus* are 17 in the male, 16 in the female. In the male there are 14 autosomes and 3 sex-chromosomes. One of these is a large V-shaped chromosome (X), while two are J-shaped (Y_1 and Y_2). The sex-chromosomes are almost equal in size and larger than the largest autosomes. In the female the two-sex (X) chromosomes are large V-shaped structures. In the reduction division of the pollen mother-cell the sex-chromosomes form a tripartite complex, of which the central X chromosome goes to one pole, and the Y_1 and Y_2 pass to the other. The behaviour of this sex-chromosome is therefore identical with that of corresponding stages in *Rumex acetosa*. The chromosomal formulæ of the plant are given as follows: ♂ diploid $14 + Y_1 + X + Y_2$, haploid $7 + X, 7 + Y_1 + Y_2$; ♀ diploid $14 + X + X$. J. L.

Chromosomes in *Ribes*.—C. D. DARLINGTON ("A Comparative Study of the Chromosome Complement in *Ribes*," *Genetics*, 1929, 11, 267–9). The conclusions drawn by Tischler from his observations on somatic divisions and meiosis in two species of *Ribes*, *R. aureum* and *R. sanguineum*, and in the hybrid *R. Gordonianum*, which results from crossing them, are considered incorrect. Tischler found the 16 chromosomes of *R. sanguineum* larger than the 16 of *R. aureum*. In meiosis in the hybrid 8 pairs were larger than the other 8, from which he concluded that autosyndesis had occurred. The assumption was also implied that the two species were tetraploid, for they had four pairing sets of four chromosomes. The present writer has re-examined the somatic mitoses in these three forms, and finds their chromosome complements similar in size and proportion, and that a similar size variation occurs within each complement, the chromosomes ranging from $1.5\text{--}2.5\mu$. The pairing in the meiotic divisions of *R. Gordonianum* would thus be normal association of eight *R. aureum* chromosomes with the corresponding eight *R. sanguineum* chromosomes, and not autosyndesis. The position of the attachment constriction gives characteristic form to the chromosome types at anaphase, revealing only two chromosomes of each type, and thus disproving the tetraploid interpretation of the chromosome complements. J. L.

Meiosis in *Ribes*.—O. MEURMAN ("Cytological Studies in the Genus *Ribes* L.," *Hereditas*, 1928, 11, 289–356). The diploid chromosome number is 16 in the 22 *Ribes* species and hybrids examined. The method of chromosome pairing is parasynaptic. Unsatisfactory fixation is considered to be the cause of the synizetic contraction. The chromosomes of the various species and hybrids differ in size, and there is also considerable range in size within the chromosome complement of any one species or hybrid. No visible hetero-chromosome pair is present in either sex. Normal and irregular meiotic divisions in *Ribes* species are described. The irregularities are rare and evidenced by the occurrence of univalents in first metaphase. Lagging chromosomes cause the formation of 7-, 8-, or 9-chromosome pollen-cells. The fertile *Ribes* hybrids, viz., *R. holosericeum*, *R. robustum*, *R. suecicrubrum*, *R. innominatum*, and *R. urceolatum*, have meiotic divisions which are usually regular. The occasionally occurring irregularities are described and are shown to be correlated with the fertility exhibited. The degree of fertility shows correlation with the degree of affinity of the parental chromosomes. In the sterile hybrids, viz., *R. Gordonianum*, *R. Culverwellii*, and *R. Carrièrei*, this affinity is very weak and the meiotic divisions highly irregular. All possible combinations from 8 bivalents with no univalents to 16 univalents and no bivalents are formed. The gemini of diakinesis are asymmetrical, and side views of metaphase show that the members of bivalents are of different sizes, i.e. the homologous parental chromosomes

differ in size. The author takes this as proof that the mode of conjugation is allosyndetic, as opposed to the view of autosyndesis. Statements by other workers concerning chromosome size and conjugation are criticised. Size difference in homologous chromosomes is considered to be one reason for irregular meiosis and consequent sterility, for in fertile hybrids the members of a bivalent are similar in size. Pollen mother-cells in which 16 univalent chromosomes remain unpaired give rise to diploid gametes, the viability of which has not been tested. The paper concludes with an account of the occurrence of diminutive chromosomes and the phenomenon of fragmentation. J. L.

Meiosis in *Oenothera*.—C. G. KULKARNI ("Meiosis in Pollen Mother-Cells of *Oenothera pratincola* Bartlett," *Bot. Gaz.*, 1929, **87**, 218–58). Various strains of *Oenothera pratincola* from Lexington, Kentucky, have been cytologically examined. Strain E differs from the other seven in genetical behaviour in giving rise to "mass mutation," among which is the peculiar mutant *formosa*. The meiotic divisions are exactly similar in strain E, mut. *formosa* and strain C, which is typical of the remaining strains. The diploid chromosome number is 14. In "diakinesis" these form a closed chain attached end to end. Occasionally the chain breaks at some point to form an open chain of 14 chromosomes. The characteristic zigzag arrangement occurs at metaphase, and anaphase is usually normal, though 6–8 divisions have been observed in about 3–7 p.c. of the cases examined. A further strain M is the cross mut. *formosa* by f. *typica* strain C. It resembles f. *typica*, whose flat-leaved character is dominant to the revolute-leaved character of the mutant. The F_2 progeny shows segregation of 3 *pratincola* f. *typica*, 1 mut. *formosa*. Strain M is similar to the other strains in all meiotic stages up to the end of second contraction. There is then formed a closed chain of 12 chromosomes with a ring of two attached to it. The ring of two breaks away from the closed chain at heterotypic metaphase, and the two chromosomes of the pair pass to different poles. These two homologous chromosomes are considered to carry respectively the genes for flat-leaf (*pratincola*) and revolute leaf (*formosa*), and their segregation and recombination account for the simple Mendelian ratio peculiar to this monohybrid. The homotypic divisions are normal and similar for all strains. Quadripartition of the pollen mother-cell is brought about by furrowing through the vacuolate cytoplasm. J. L.

Meiosis in *Cocos*.—JOSÉ K. SANTOS ("A Cytological Study of *Cocos nucifera*," *Philippine Journ. Sci.*, 1928, **37**, 417–37). The meiotic divisions of the pollen mother-cells of *Cocos nucifera* are described in detail. In early prophase there are no indications of the association of parallel threads. The nucleolus undergoes great increase in size during prophase, but later becomes reduced, probably as the result of contributing material to spireme formation. On emerging from synapsis the single spireme is thrown into 16 loops, each representing a bivalent chromosome. The method of chromosome pairing is thus clearly telosynaptic. Size differences are apparent in the bivalent chromosomes, one pair being considerably larger and three smaller than the rest. The heterotypic and homotypic divisions show no exceptional features. J. L.

Meiosis in *Lycoris*.—I. NISHIYAMA ("Reduction Division in *Lycoris*," *Bot. Mag., Tokyo*, 1928, **42**, 509–13, Japanese, with English summary). The somatic chromosome numbers of two species of *Lycoris* have been determined as follows: *L. sanguinea* Maxim. 22, *L. radiata* Herb. 33. In these species the chromosome numbers at heterotypic metaphase are 11 bivalents and 11 trivalents respectively. *L. radiata* is thus seen to be a triploid species. The complete sterility of this triploid is caused mainly by meiotic irregularities. J. L.

Internal Structure of the Nucleolus.—J. McA. KATER ("Structure of the Nucleolus in the Root-Tip Cells of *Nicotiana longiflora*," *Univ. Calif. Publ. Bot.*, 1928, 14, 319–22). Root-tips of *Nicotiana longiflora*, fixed in Karpechenko's solution, when properly destained show a reticulum within the cortical portion of the nucleolus. This appears continuous with the nuclear reticulum and never penetrates the nucleolar vacuoles. This reticulum disappears during prophase. It has not been demonstrated with any other fixative. J. L.

Heterotypic Prophases of Cotton.—J. M. BEAL ("A Study of the Heterotypic Prophases in the Microsporogenesis of Cotton," *La Cellule*, 1928, 38, 247–68). The heterotypic figures are described and figured for two varieties of *Gossypium barbadense* L., the Pima variety of Egyptian cotton, and a commercial strain of Sea Island cotton. In normal anthers the archesporial cells appear to give rise directly to the pollen mother-cells, with no intervening premeiotic division. At the onset of prophase the peripheral chromatic masses of the pollen mother-cell nuclei form an irregular thread-like reticulum composed of single strands. These strands show side by side approximation in pairs previous to synizesis. Some of these paired strands show pronounced twisting about one another. After synizesis the spireme appears to be continuous and is clearly double and much twisted. The nucleolus lies free in the nuclear sap without connection to the spireme. During this stage the loculi of the anthers extend considerably. The walls of the pollen mother-cells remain attached to the tapetum and are therefore stretched, but the protoplasts do not increase in proportion, and thus become separated from the walls. The protoplasts round up and form a new, independent wall. The old walls persist throughout all the subsequent meiotic stages. A dense "perinuclear zone" now appears in the cytoplasm, and from its inner part the spindle fibres later originate. The spireme shortens and thickens, but shows no typical "second contraction." The double thread shows alternate masses of thick and thin chromatic material, and undergoes transverse segmentation by breaking at the thinner parts. The thick portions are then clearly recognised as bivalent chromosomes formed by para synapsis. There is no evidence of a longitudinal split in the univalent strands either before or after segmentation. The haploid chromosomes are 26 in number, and show considerable variation in size. J. L.

North American Violets.—A. GERSHOY ("Studies in North American Violets. 1. General Considerations," *Bull.* 1928, 279, *Univ. Vermont and State Agri. Coll., Vermont Agri. Exper. Station*). Species and species crosses of *Viola* of the sections *Dischidium* Ging., *Nomimum* Ging., *Chamamelanium* Ging., and *Melanium* Ging. have been studied cytologically. Polyploidy is displayed within the group, the haploid numbers varying from 6–27. Hybridisation cannot be considered to be the cause of the polyploid condition, for hybrids involving parents with unlike chromosome numbers are sterile. With each higher multiple in chromosome number there is progressive diminution in chromosome size, but no direct evidence for the origin of polyploidy in chromosome fragmentation. A close morphological relationship between species is correlated with the occurrence of identical chromosome number. Both the morphological- and chromosome number-relationships of species are correlated with the degree of sterility of hybrids obtained by crossing them. Meiotic irregularities and pollen degeneration are associated with seed sterility. F_1 hybrids show intermediate inheritance in varying degrees, and, by inbreeding, these features may be permanently established. A brief account is given of the genetics, taxonomy, and phylogeny of the group. J. L.

Polyploidy in *Betula*.—R. H. WOODWORTH ("Cytological Studies in the *Betulaceae*. 1. *Betula*," *Bot. Gaz.*, 1929, 87, 331-62). The following species and hybrids of the polymorphic genus *Betula* ($n = 14$) have been cytologically examined and their chromosome numbers recorded during microsporogenesis. *B. lenta* $n = 14$, *B. nigra* $n = 14$, *B. schmidtii* $n = 14$, *B. caerulea-grandis* \times *populifolia* $n = 14$, *B. caerulea-grandis* $n = 14$, *B. fontinalis* var. *piperi* $n = 14$, *B. japonica* $n = 14$, *B. pendula* Roth. *B. verrucosa* Ehrh. $n = 14$, *B. populifolia* $n = 14$, *B. maximowicziana* $n = 14$, *B. lenta* \times *pumila* (*B. jackii*) $n = 21$, *B. verrucosa* \times *pubescens* $2n = 42$, *B. pumila* $n = 28$, *B. papyrifera* var. *cordifolia* $n = 28$, *B. pubescens* $n = 28$, *B. japonica* var. *mandshurica* $2n = 56$, *B. papyrifera* $n = 35$, *B. lutea* $n = 42$, *B. grossa* $n = 42$, *B. sandbergi* (*B. papyrifera* \times *pumila* var. *glandulifera*) $2n = 63$, $n = 31, 32$. *B. davurica* $n = 45$? *Betula* is thus seen to be a polyploid genus containing diploid, triploid, tetraploid, pentaploid, hexaploid, and dysploid (aneuploid) species and hybrids. Meiotic irregularities are characteristic of plants of known hybrid origin. Hybridisation leads to the production of polyploid gametes, either by non-reduction or by semi-heterotypic division; consequently heterozygosis is to be considered one of the methods of the origin of polyploidy. Species of *Betula* are known to hybridise very readily, which fact would account for the high degree of polymorphism and multiplicity of species within the group. J. L.

CRYPTOGAMS.

Pteridophyta.

Isoëtes.—A. V. DUTHIE ("The Method of Spore Dispersal of Three South African Species of *Isoëtes*," *Ann. Bot.*, 1929, 43, 411-12). An investigation of the method of spore dispersal of three species of *Isoëtes* recently described in South Africa, which flourish in the rainy season and disappear, all but the corm, during the dry summer, leaving heaps of naked megaspores and microspores among the old corm scales. By a few weeks later the spores have disappeared, and, further, it is noticed that young sporophytes are always found at some distance from the old plants. The explanation is to be found in the earthworms observed in the moist soil around the corms. Some of these were collected, washed, and kept in a jar until the worm-casts could be examined, and these were found to contain an abundance of megaspores and microspores which had passed uninjured through the worm's body. Certain water snails may also help to distribute the spores.

A. G.

Cytoplasm of *Equisetum*.—ROBERT H. BOWEN ("Notes on the Chondriosome-like Bodies in the Cytoplasm of *Equisetum*," *Ann. Bot.*, 1929, 43, 309-27, 2 pls.). In the cytoplasm of *Equisetum arvense* the chondriosome-like bodies are of two different categories. One type forms the *plastidome*, elements of varied shape, from which leucoplasts and chloroplasts become differentiated. The other type forms the *pseudochondriome*, elements of small spherical shape, whose function is unexplained. These two classes of bodies are independent and have different staining reactions and functions. These conclusions confirm, in the main, the previous findings of Pensa, Mottier, Dangeard, and Emberger, but not Senjaninova's recent results in *Nephrodium*. The chondriosome-like bodies in *Equisetum* cannot as yet be regarded as the actual homologues of the chondriosomes in animal cells.

A. G.

Spore Germination of Ferns.—YŌNOSUKE OKADA ("Notes on the Germination of the Spores of Some Pteridophytes, with Special Regard to their Viability,"

Sci. Rep., Tôhoku Imp. Univ., 1929, Biology, 4, no. 1, 127-82). The results of an investigation of the germination of fern spores: (1) In reference to the effect of external conditions; (2) as to the viability of the spores. The species studied were *Equisetum arvense*, *Osmunda japonica*, *O. cinnamomea*, *Dryopteris viridescens*, *Woodwardia orientalis*, and to a less extent *Matteuccia struthiopteris*. Pure water was of little or no use as a substratum; Knop's solution was satisfactory. The extremes of temperature were 10° and 25° C., 40° being the optimum. Gas-filled electric lamps were less favourable than the vacuum type. Direct rays of sunlight were unfavourable. Feeble illumination still permits germination, but in darkness some of the species remained inert. They were all inert when oxygen was withheld. As to viability, or span of life, spores of *Woodwardia* survived for about 190 days, *Matteuccia* for nearly 150, *Dryopteris* for over 100, *Osmunda cinnamomea* for over 50, *O. japonica* for over 40, *Equisetum* for 10-24 days. Viability is promoted more by dark cold conditions than by warmth and illumination; more by dryness than moisture. Red light proved destructive to *Equisetum* and *Dryopteris*, and blue light to *Osmunda cinnamomea*. *Equisetum* spores are remarkable as showing decided signs of respiration. A. G.

Sporangia on *Scolopendrium Prothallus*.—WILLIAM H. LANG ("On a Variety of *Scolopendrium vulgare* that Bears Sporangia on the Prothallus," *Ann. Bot.*, 1929, 43, 355-74, 1 pl., 6 figs.). An account of the prothallus of a variety of *Scolopendrium vulgare* with ramo-digitate fronds which form sori on both the upper and lower surface. This fern breeds true, and, when watered from above, produces young plants by normal fertilisation. The remarkable thing is that some of the large prothalli in old cultures, in which fertilisation has been prevented, have occasionally produced groups of sporangia both above and below, some distance behind the anterior margin. A vascular strand is present in the sporangium-bearing region. The anterior prolongation may bear archegonia. At its anterior margin apogamously produced young plants arise. The author discusses some special features of this induced apogamy and the production of sporangia on a prothallus. A. G.

Cuticle of *Neuropteris*.—E. BOLTON ("On the Cuticle of Certain Species of *Neuropteris* Brongn.," *Ann. Bot.*, 1929, 43, 414-15). Some notes on an examination of fossil pinnules of *Neuropteris flexuosa* and allied species prepared by the methods of Walton and of Ashby. Hairs were observed on both surfaces of the lamina, and especially on the veins and near the base of the pinnule. Each hair is unicellular and unbranched, thick-walled, and rising from a broad base to a blunt apex. The stomata agreed in all points with those described for *N. heterophylla* by Miss Wills in 1914, and water-pores were also observed. Suitable preparations of cuticle could not be prepared for comparative examination. A. G.

American Ferns.—WILLIAM R. MAXON ("New Tropical American Ferns.—VI," *American Fern Journ.*, 1929, 19, 44-8). Descriptions of three new ferns—*Hemitelia superba*, collected by G. S. Jenman in British Guiana, and formerly ranged with *H. multiflora*; *Asplenium psilacrum*, from Panama (R. S. Williams); *Polystichum spongiosum*, from Haiti (E. L. Ekman). Critical notes are appended. A. G.

Bryophyta.

Asterella.—ARTHUR W. HAUPT ("Studies in Californian Hepaticæ. I. *Asterella californica*," *Bot. Gaz.*, 1929, 87, 302-18, 1 pl., 21 figs.). A morphological study of *Asterella californica*, formerly under the generic name *Fimbriaria*. The thallus, receptacles, reproductive organs and embryo (of *A. Palmeri*) are described.

The species is common in California. The thallus grows by means of a single large cuneate apical cell; the ventral surface bears two rows of appendaged scales, and both smooth and pegged rhizoids. The air chambers arise schizogenously and lack chlorophyllose filaments. The air pores are simple mostly, but barrel-shaped on the female receptacle. The male receptacle is a simple dorsal upgrowth of the thallus; but the female is a definite branch system, with apical cell, and forms four conspicuous lobes. Normally two or three archegonia arise in each group. After the formation of such a carpocephalum, two adventitious apical cells are formed which carry on the growth of the thallus, leaving the carpocephalum in the fork. The development of the antheridium is much as in other Marchantiales. In the archegonium the ventral canal cell and egg are differentiated after four neck canal cells are formed, four more neck cells being added thereafter. The embryo of *A. Palmeri* becomes by transverse divisions a filament of four cells, and presumably the lowest cell gives rise to the foot, the next one to the seta, and the upper two to the capsule. A. G.

Plagiochila.—PIERRE ALLORGE ("Le *Plagiochila tridenticulata* (Hook.) Dum. dans les Pyrénées Basques," *Annales Bryologici*, 1929, 2, 2-4). *Plagiochila tridenticulata* is a rare hepatic of Atlantic type, which has been recorded from Norway, British Isles, Normandy, Canary Isles. And now another station for it has been discovered in the Basque Pyrenees. The nature of this locality and of its bryophyte vegetation is described. A note is added in connection with the specific validity of this plant. A. G.

Frullania in Malaya.—FR. VERDOORN ("V. Schiffner.—Expositio plantarum in itinere suo indico annis 1893-94 suscepto collectarum speciminibusque exsiccatis distributarum, adjectis descriptionibus novarum: series tertia (no. 1473-2460): Frullaniaceas continens," *Annales Bryologici*, 1929, 2, 117-54, 10 figs.). This is a continuation by F. Verdoorn of V. Schiffner's enumeration of his Malayan hepatics collected in 1893-4, and partly published in *Denkschr. K. Akad. Wiss. Wien*, 1898, 1-51; 1900, 52-116. The present instalment contains the Frullaniaceæ, and cites the label of every specimen collected in Java and Sumatra by Schiffner. Among the novelties are a new sub-genus, *Saccophora*, three new species, and eight varieties. A. G.

Revision of Frullania.—FR. VERDOORN ("Revision der von Java und Sumatra angeführten Frullaniaceæ," *Annales Bryologici*, 1929, 2, 155-64). A revision of the species of *Frullania* recorded for Java and Sumatra in the following three works: (1) C. M. van der Sande Lacoste: Synopsis Hepaticarum Javanicarum (1857)—3 out of 10 new species are now reduced; (2) V. Schiffner: Hepaticæ Massartianæ Javanicæ (1900)—3 new species are reduced; (3) Franz Stephani: Species Hepaticarum (1909-12)—out of 25 new species 21 (or possibly 23) must be reduced. A list is added of 40 valid species of *Frullania* which occur in Java and Sumatra. A. G.

Japanese Hepaticæ.—YOSHIWO HORIKAWA ("Studies on the Hepaticæ of Japan.—I.," *Sci. Rep., Tôhoku Imp. Univ.*, 1929, Biology, 4, no. 1, 37-72, 4 pls., 6 figs.). The author provides a bibliography of 169 papers, and begins a study of the hepatics of Japan with descriptions of five genera and eight species, with excellent figures. Two species of *Frullania* are new to science. A. G.

Japanese Hepatics.—V. SCHIFFNER ("Über epiphyllle Lebermoose aus Japan nebst einigen Beobachtungen über Rhizoiden, Elateren und Brutkörper," *Annales Bryologici*, 1929, 2, 87-106, 8 figs.). Five epiphyllous hepaticæ are here

described and discussed. They were collected by Prof. Hans Molisch in South Japan, where at one place only did he observe any epiphyllous species. Among them are three new species. The author adds notes on the rhizoids, elaters, and gemmæ of the plants. A. G.

Karyostrophe in Hookeria.—A. J. M. GARJEANNE ("Karyostrophe bei *Hookeria lucens*," *Annales Bryologici*, 1929, 2, 25–34, 2 figs.). A résumé of what is known as Karyostrophe or balling of the chlorophyll corpuscles around the nucleus. This condition is sometimes remarkably shown in *Hookeria lucens*, but the cause and method of it were unknown. The author discusses it at some length and shows that it may be induced by wounding the leaves. The experiments are described. The stimulus of the injury passes basipetally along the tissues. Karyostrophe comes on within an hour, and passes off in two to four days. A. G.

Ephemeropsis.—MAX FLEISCHER ("Die Sporenkeimung und vegetative Fortpflanzung der *Ephemeropsis tjibodensis*," *Annales Bryologici*, 1929, 2, 11–20, 2 pls.). The very remarkable moss *Ephemeropsis tjibodensis*, first found in Java, has now been recorded for Sumatra, Malacca, New Guinea, Siam, the Philippine Islands, and even for New Zealand. The protonema is enormously developed and persistent, with the gametophyte generation reduced almost to the antheridia and archegonia, and with a small but highly developed sporophyte of Hookeriaceous affinity, with double peristome, but with conspicuously large spores, measuring 30–50 μ . The germination of the spores is described and figured, with the formation of the protonema and its assimilation organs and haptera, also the brood-bodies, the male inflorescence, an old capsule with sprouting spores and with aposporous protonema arising from the wall, etc. A. G.

Pseudoleskeopsis.—I. THÉRIOT ("Le genre *Pseudoleskeopsis*," *Ann. de Cryptogamie exotique*, 1929, 2, 5–22, 8 figs.). A revision of the genus *Pseudoleskeopsis* created in 1907 by V. F. Brotherus, and showing affinity with *Haplocladium*. It contains two sub-genera—(1) *Eu-Pseudoleskeopsis* Thér. with five species, and (2) *Pseudo-Pterogonium* (Broth.) Thér. with six species. These are critically discussed, and figured where necessary, and eight species are excluded from the genus. A. G.

Russian Sphagna.—Z. N. SMIRNOVA ("The Distribution of *Sphagnum contortum* Schultz and *Sphagnum quinquefarium* (Lindb.) Warnst. in U.S.S.R.," *Annales Bryologici*, 1929, 2, 107–16, 2 figs.). *Sphagnum contortum*, a western European species, was discovered in the middle Ural Mountains in 1925, and *S. quinquefarium* is a rare species in Russia. The distribution of these two species in Russia is recorded and shown on maps, and a bibliography is added. A. G.

Mosses of Schlesvig-Holstein.—FRITZ KOPPE ("Das Montane Element in der Moosflora von Schlesvig-Holstein," *Annales Bryologici*, 1929, 2, 35–66). An account of the moss flora of Schlesvig, with special reference to its mountain elements and to the distribution of these in Europe. The plants are arranged in the following groups:—subalpine (5 mosses); eumontane (22 hepatics, 33 mosses); submontane (16 mosses), etc. Remarks are added on the biology and ecology of the montane mosses found in the lowlands. A. G.

Bavarian Mosses.—H. PAUL ("Zur Bryogeographie des Bayerischen Waldes," *Annales Bryologici*, 1929, 2, 67–86). The Bayerische Wald lies to the east of Regensburg, is a portion of the Bohemian forest and of the much larger Hercynian forest of Middle Europe. The geology of the region is briefly sketched,

the distribution and ecology of the bryophytes are discussed, and the species are arranged in groups according to the conditions which they prefer—Mediterranean, Atlantic, Northern, alpine, montane, etc. A. G.

Seychelles Mosses.—H. N. DIXON ("On a Small Collection of Mosses from the Seychelles," *Annales Bryologici*, 1929, 2, 5–9). A list of 15 mosses collected by the Rev. Père Quirin in the Seychelles in 1921. Among them are three new species, one of which, *Himantocladium seychellarum*, represents a genus never before recorded for the African region. *Syrrhopodon mahensis* Besch., an endemic species, occupied more than one-third of the collector's packets. A full description is given of the imperfectly known *Leucoloma Isleanum* Besch. A. G.

Thallophyta.

Algæ.

Manchurian Algæ.—B. W. SKVORTZOW ("Einige neue und wenig bekannte Chlamydomonadaceæ aus Manchuria," *Archiv. für Protistenk.*, 1929, 66, 160–3, 15 figs.). Descriptions and figures of 12 new species of Chlamydomonadaceæ collected in waters near Ertzendziantze, a station on the Chinese railway in North Manchuria. A. G.

Diatoms on Mosses.—HERBERT BEGER ("Atmophytische Mossdiatomeen in den Alpen," *Festschrift Hans Schinz. Beiblatt zur Vierteljahrsschrift der Naturforsch. Ges. in Zürich*, 1928, Jahrg. 73, no. 15, 382–404). An account of the diatoms found on terrestrial mosses on the Alps, with the results of the investigation arranged in tables, which show the respective species of diatoms obtained from several mosses and hepatics collected in various habitats and at various localities in Tirol and Switzerland, together with a discussion of the two types of diatom-combination involved—the one being characteristic of mosses of xerophytic habit, the other of mosses that live in moister environments. A. G.

Austrian and Bohemian Algæ.—GÜNTHER BECK-MANNAGETTA ("Neue Grün- und Blaualgen aus Kärnten und den Sudeten," *Archiv. für Protistenk.*, 1929, 66, 1–10, 12 figs.). Descriptions and figures of 12 new species of freshwater algæ collected in the mountains of Carinthia and the Sudetes, and belonging to the genera *Zygnema*, *Cosmarium*, *Euastrum*, *Oocystis*, *Dactylothece*, *Elakatothrix*, *Ankistrodesmus*, *Stigonema*, *Glæocapsa*, *Glæothece*, *Holopedia*. A. G.

Terrestrial Algæ.—H. KUFFERATH ("Algues et Protistes muscicoles, corticoles et terrestres récoltés sur la montagne de Barba (Costa-Rica)," *Ann. de Cryptogamie exotique*, 1929, 2, 23–52, 32 figs.). A list of 64 algæ and 11 amœbæ from Costa Rica obtained by searching and washing specimens of mosses, hepatics, lichens, and epiphytic plants collected on Mt. Barba at an altitude of 2,000 m. by E. Echeverría, and sent in a dried state to Brussels in 1920. Three genera, sixteen species, and some forms are described for the first time. The new genera are *Cyanocloster*, *Echeverriopsis*, *Hetero-cyanococcus*, all belonging to the Cyanophyceæ. A. G.

Lithophytic Cyanophyceæ.—A. ERCEGOVIĆ ("Sur quelques nouveaux types des Cyanophycées lithophytes de la côte adriatique," *Archiv. für Protistenk.*, 1929, 66, 166–74, 3 figs.). Descriptions of three new genera of Cyanophyceæ found on or in maritime rocks in the tidal zone on the coast of Dalmatia. *Hormathonema* forms a thin crust on the surface of stones; it is composed of short erect filaments, which are few-celled, simple or little-branched, the cell membranes are thick and

lamellose. The one species is *H. paulocellulare*. *Tryponema* is composed of long filaments which penetrate vertically into stone, one cell thick, laterally branched, with cells cylindric. The only species is *T. endolithicum*. *Kyrtuthrix* is composed of long germinate ensheathed filaments which penetrate vertically into stone; they are uniseriate, of short cells, and are attenuated at base into a hair point; they have intercalary heterocysts. There is one species, *K. dalmatica*. The first and second genera are ascribed to Pleurocapsaceæ, and the third to Rivulariaceæ. A. G.

Arthrospira.—M. KOCZWARA (" *Arthrospira leopoliensis* Racib. i formy pokrewne," *Kosmos*, 1928, 53, fasc. 1, 102-8, 3 figs.). A note on *Arthrospira leopoliensis* and its affinity. It is here made the type of a new genus of Cyanophyceæ namely, *Raciborskia*, to which are added two new species—*R. elegans* and *R. gracilis*. All three occur as plankton near Lwow in Poland. A. G.

Volvox.—CAROLINE A. LANDER (" Oogenesis and Fertilization in Volvox," *Bot. Gaz.*, 1929, 87, 431-6, 1 pl.). A cytological study of *Volvox globator*. The results are summed up as follows: Starch is formed from the pyrenoids in the vegetative cells, in all stages of division of the asexual colony, in all stages of the egg before and after fertilisation, and in the mature zygote. It is most actively formed in the mature egg and in the early stages after fertilisation. The nuclei of the daughter colony cells remain on the inward side of the cell, but as the colony matures, the pore enlarges and the colony turns inside out through the enlarged pore. Sperms enter the side of the egg from the inside of the colony through a pore in the oogonium wall, behind which is a receptive spot. The sperm nucleus increases greatly in size and comes in contact with the egg nucleus. The nuclear membranes of the egg and sperm dissolve at the point of contact, and the sperm nucleolus and its chromatin mass enter the egg nucleus. In the mature zygote the chromatin masses have united. A. G.

Vaucheria geminata.—J. R. MUNDIE (" Cytology and Life-History of *Vaucheria geminata*," *Bot. Gaz.*, 1929, 87, 397-410, 2 pls.). In Virginia *Vaucheria geminata* produces its sexual reproductive organs most abundantly in September-October. The egg nucleus undergoes mitosis just before the vegetative nuclei, and the nuclear membrane temporarily disappears in both vegetative and reproductive nuclei during mitosis. Spindle fibres are seen in the vegetative nuclei in the metaphase. When the sperm enters the oogonium, the cross wall begins to form, and the vegetative nuclei then disintegrate. There is no migration of nuclei. The male element enters the oogonium through a swelling formed in the "receptive region" of the oogonium. Fertilisation occurs late in the night. Maturation divisions in the egg nucleus occur in the afternoon. The formation of the cross wall, the disintegration of the vegetative nuclei, and the fusion of the gamete nuclei occur in the late night and early morning. The number of vegetative nuclei in the oogonium varies from about 50 to 140; they increase much during mitosis. The fusion of the gamete nuclei is delayed until the male has grown almost to the size of the female gamete by its side. After fertilisation a vacuole structure is formed in the middle of the oogonium, and in the midst of this the zygote nucleus takes up its position. A. G.

Botrydium.—V. MILLER (" Untersuchungen über die Gattung Botrydium Wallroth," *Ber. Deutsch. Bot. Ges.*, 1927, 45, 151-70, 1 pl.). This investigation of *Botrydium* is divided into two parts. The first treats of the morphology and development of this alga, its stages of growth, nutrition and rest, its reproduction by zoospores, and by uninucleate and multinucleate spores, its cytoplasmic structure

and reactions. The second part is concerned with a definition of the species of *Botrydium* investigated, namely, *B. granulatum* Grev. with two varieties, *B. Wallrothi* Kütz., *B. tuberosum* Iyengar, and *B. pachydermum*, which is described for the first time.

A. G.

Westphalian Algæ.—HERM. BUDDE ("Die Rot- und Braunalgen des Westfälischen Sauerlandes," *Ber. Deutsch. Bot. Ges.*, 1927, 45, 143-50). A contention that the freshwater representatives of the red and brown algæ are far from being so rare as they have been supposed to be. For instance, if *Hildenbrandia rivularis*, when searched for in the Sauerland of Westphalia, has proved to be so widespread, it must be equally common in the hilly parts of middle Germany. The author gives descriptions of *Chantransia violacea*, *Pseudochantransia chalybea*, and *P. Lemanæ*, and notes on the habitat and periodicity of each of these red algæ, and similar notes on the occurrence of *Batrachospermum*, *Hildenbrandia* and *Lemanea*. The only representative of the brown algæ found in Westphalia is *Lithoderma fontanum*, which, though difficult to find, is widely distributed.

A. G.

Algæ of the West Indies.—GONTRAN HAMEL ("Contributions à la flore algologique des Antilles," *Ann. de Cryptogamie exotique*, 1929, 2, 53-8, 1 fig.). The beginning of a series of notes on the algæ collected in Guadeloupe by Mazé and Schramm, in Martinique by Belanger and Beau, in French Guiana by Leprieur and Beau. The present instalment treats of *Porphyra*, *Erythrotrichia*, *Bangiopsis*, and *Goniotrichum*.

A. G.

Delesseriaceæ of New Zealand.—HARALD KYLIN ("Die Delesseriaceen Neu-Seelands," *Lunds Universitets Årsskrift*, 1929, N.F., Avd. 2, Bd. 25, nr. 2, 1-15, 12 pls.). A revision of the Delesseriaceæ of New Zealand, illustrated by nearly thirty photographic reproductions of the species studied, including type plants preserved in J. G. Agardh's herbarium. The genera of Delesseriaceæ comprise *Bartoniella* (1 new species), *Phytomphora*, *Laingia* (a new genus founded on *Delesseria Hookeri* Lyell), *Apoglossum*, *Delesseria*. The genera of Nitophylleæ are *Phycodrys*, *Myriogramme* (with 6 species, 1 being new), *Schizoseris*, *Acrosorium*, *Hymenena* (a difficult genus with 8 species).

A. G.

Canary Algæ.—F. BØRGESEN ("Marine Algæ from the Canary Islands, especially from Teneriffe and Gran Canaria. III. Rhodophyceæ. Part II. Cryptonemiales, Gigartinales and Rhodymeniales," *Kgl. Danske Vidensk. Selsk.*, 1929, 8, 1-97, 4 pls., 31 figs.). The final instalment of the author's account of the algæ of the Canary Islands, including Mme. Lemoine's report on the troublesome group of the Melobesiæ. There are 29 of the latter, and only five of these are found in the West Indies. About as many more, however, are closely allied to West Indian species. As to the other algæ (not calcareous), about one-half are common to the Canaries and West Indies. There are eight new species among the Melobesiæ, and a new *Hildenbrandia*.

A. G.

Sporangia of Ectocarpus.—NILS SVEDELIUS ("On the Number of Chromosomes in the Two Different Kinds of Plurilocular Sporangia of *Ectocarpus virescens*," *Svensk Bot. Tidskrift*, 1928, 22, H. 1-2, 289-304, 4 figs.). A discussion of the different kinds of sporangia found in various species of *Ectocarpus*. In the alternation of generations of the Phæophyceæ the reduction-division in the Laminariaceæ occurs in the sporangium before the formation of the zoospores, as also in the Cutleriaceæ and in Dictyotaceæ. In the Ectocarpaceæ it also occurs in the unilocular sporangia, but alternation does not proceed so regularly in this

group; each generation has the power of repeating itself before swinging over to the other phase. In *Pylaiella* there is (1) a haploid monoicous sexual generation which forms isogametes in plurilocular sporangia; by fusion of these isogametes the diploid generation is developed; (2) the diploid plants are morphologically similar to the haploid, but eventually they bear unilocular sporangia in which reduction-division occurs at the first division, so that the spores are haploid and produce plants of the haploid generation again in early spring. The regularity of the alternation may be rendered irregular by each generation reproducing and repeating itself before changing over—(1) the haploid by parthenogenetic spores formed in plurilocular sporangia; (2) the diploid by neutral spores formed in plurilocular sporangia. The plurilocular sporangia are to be regarded as more ancient organs than the unilocular. But some species of *Ectocarpus* have two or even three kinds of plurilocular sporangia. *E. (Giffordia) secundus* has two kinds—(1) with numerous small loculi (antheridia); (2) with few large loculi (oogonia); and these latter, in the absence of antheridia, develop parthenogenetically. Again, *E. Padinae* has three kinds—(1) with very small loculi (antheridia); (2) with middle-sized loculi (meiosporangia); (3) with rather large loculi (megasporeangia); but which of the two latter is oogonial, and what may be the function of the other, is unknown, but possibly neutral diploid zoospores may be formed. However, no unilocular sporangia have been found. *E. virescens* also has no unilocular sporangia, but has two kinds of plurilocular sporangia—(1) meiosporangia; (2) megasporeangia, but never both on the same plant; and the spores develop without copulation of any sort. The dimensions and cytological structure of these spores are described. The number of chromosomes in each is the same, and it is probably a matter of lost sexuality. In *Ectocarpus*, then, there are four types—(1) *E. siliculosus*, with swarmspores all alike, gametes, which sometimes develop apogamously; (2) *E. virescens*, with meiosporangia comparable in size with the gametangia of *E. siliculosus*, and megasporeangia; both have lost their sexuality and develop apogamously; (3) *E. secundus*, with antheridia and oogonia, the latter capable of apogamy; (4) *E. Padinae*, with antheridia, meiosporangia and megasporeangia, the two latter capable of apogamous development.

A. G.

Embryo of Turbinaria and Sargassum.—MASATO TAHARA ("Rhizoid Formation in the Embryo of Turbinaria (?) fusiformis Yendo and Sargassum Thunbergii O. Kuntze," *Sci. Rep., Tôhoku Imp. Univ.*, 1929, Biology, 4, no. 1, 1-6, 4 figs.). In pursuing his theory that a study of the rhizoid formation in the embryo of Fucaceous algae affords an important clue to the systematic position of each species, the author describes what he has found in *Turbinaria fusiformis* and *Sargassum Thunbergii*. *T. fusiformis* is a common Japanese alga. Its reproductive process is here described. After fertilization the rhizoid initial cell is cut off by the second segmentation wall and divides into four quadrants. The next set of divisions is irregular, but produces an 8-cell stage, from each of which a rhizoid is formed which resembles what the author has previously described for *Coccophora Langsdorfii*. The species was first described by Harvey under *Cystophyllum*. Yendo suggested *Turbinaria*. *Sargassum* is unsuitable. As to *Sargassum Thunbergii*, the author does not regard it as happily placed in *Sargassum*. It has much in common with the above-mentioned *T. fusiformis*, especially in the rhizoid formation of its embryo.

A. G.

Furcellaria.—ACHILLE FORTI ("Furcellaria fastigiata definitivamente riconfermata rinvenirsi nel Mediterraneo," *Studi sulla Vegetazione nel Piemonte*, pubblicati a ricordo del II Centenario della fondazione dell'Orto Botanico della R. Università di Torino (1729-1929), *R. Istituto Botanico di Torino*, 1929, 1-30,

5 pls.). *Furcellaria fastigiata* is a northern alga which is very rare in the Mediterranean. The recent finding near Monterosso, in Riviera di Levante, has led the author to revise the older records of the plant, some of which are represented by photography, together with some specimens from more northern latitudes. Allioni received the true plant from Bellardi in 1816. Strafforello gathered it at Porto Maurizio in 1874. Some of the old specimens referred to *Furcellaria* have proved to be *Gymnogongrus Griffithsiae* and *Gelidium crinale*. A. G.

Fungi.

Study of Synchytrium.—SHUNSUKE KUSANO ("The Relative Sexuality in *Synchytrium*," *Proc. Imp. Acad., Tokyo*, 1928, 4, no. 8, 497-9). Kusano gives results of his study of *Synchytrium fulgens*, a parasite of *Oenothera*. He has found that the zoospores, hitherto regarded as sexual reproductive cells, are planogametes; two of them fuse, and the zygote thus formed enters on a resting stage and becomes a gametangium. The planogametes are all alike and all active, but in time they become sedentary and spherical. At that stage a still active gamete representing maleness fuses with the sedentary cell representing femaleness. A male attempting fusion may meanwhile become sedentary (female) and become fused with a still active "male" cell. Kusano concludes that it is a case of relative sexuality that the gamete may in turn be either male or female. The case of *Ectocarpus siliculosus* is cited, where the gametes act in much the same way, but with this difference—that in *Synchytrium* there is no definite sex in any gamete, and the condition is indicative of a certain life-stage reached by the swarming cells.

A. L. S.

Phytophthora on Antirrhinum.—S. SUNDARARMAN and T. S. RAMAKRISHNAN ("Foot-Rot and Wilt of Antirrhinums," *Mem. Dept. Agric., India*, 1928, 16, 83-100, 7 pls. (2 col.)). The disease was noted in the Botanical Garden at Ootacamund; the plants were found to wilt and die before blossoming. Microscopic examination showed the presence of *Phytophthora* sp. in the tissues of root and stems. Oospores were present; the mycelium was both inter- and intra-cellular; no haustoria were observed, but the hyphae could be seen passing through the cell-walls. Cultures, or artificial media and inoculation experiments, were undertaken. These are explained and described—the behaviour of the mycelium, the formation of sporangia and of zoospores, and finally the appearance of the sexual organs antheridia and oogonia; these may be borne on the same or on different hyphae, i.e. the antheridia are amphigynous or paragynous. The systematic position of the fungus is carefully gone into; it was found to have close affinity with *Phytophthora pini*, but with sufficient differences to establish a variety *Antirrhini* nov. var., the diagnosis of which is given.

A. L. S.

Olpidium Trifolii.—SHUNSUKE KUSANO ("Observations on *Olpidium Trifolii* Schroet.," *Journ. Coll. Agric. Imp. Univ., Tokyo*, 1929, 10, no. 2, 83-99, 7 text-figs.). The fungus investigated was found at Kyoto, Japan, and later at several other localities, on *Trifolium repens*. It produces small swellings on the leaves and irregular protuberances on the petioles, etc. The leaves may be distorted when heavily infected. *Trifolium repens* was introduced into Japan several decades ago and is now very common; but the fungus has only appeared recently, and may have been introduced on dried leaves. *Trifolium pratense*, equally common, is not affected by the disease. Kusano has made a prolonged study of the fungus, which he retains in the genus *Olpidium*. He found the gametangia filling the host cells. They are provided with beaks which pierce

the host cell and through which are liberated the planogametes ; these are hyaline, with a long posterior cilium. When the gametes emerge, copulation between two gametes takes place, presumably from different gametangia—a form of isogamy ; the planozygote which is thus formed develops into the resting cell. Without copulation a single gamete is able parthenogenetically to form the gametangium, which, however, is normally the result of fusion. All these developments are carefully described and the effect on the host tissues.

A. L. S.

Pythium on Opuntia.—T. S. RAMAKRISHNA AYYAR (" *Pythium aphanidermatum* Fitz. on *Opuntia Dillenii* Haw.," *Mem. Dept. Agric., India*, 1929, 16, 191–201, 3 pls.). The *Pythium* here described has a wide distribution and attacks many economic plants. It causes rotting of the *Opuntia*, and may be found on any part of the plant. It was found quite easy to grow on artificial media, and many scientific observations were made on the cultures and as to the effect of inoculation on the different parts of the host plant. It was determined as *Pythium aphanidermatum*, and with it *Pythium Butleri* has been associated as a strain. The two fungi differ only in a slight variation of the size of the oogonia. The strain *P. Butleri* is particularly destructive on papayas.

A. L. S.

New Pythium Species.—A. MEURS (" Ein neuer Wurzelbrandneger der Zucker-und Futterrüben," *Phytopath. Zeitschr.*, 1929, 1, 111–16, 2 text-figs.). The *Pythium* described by A. Meurs was found by him causing a disease of the roots of beets. Three diseases of sugar-beet roots are known in Europe, but the *Pythium* had not been previously detected. It has been described as *P. mamillatum* n. sp., and differs from other members of the genus in the characteristically echinulate oogonia, the outer processes being cone-shaped and blunt at the tips. The fungus was grown on various artificial media, and the different stages of development were followed. The fungus was found only in the main roots of the beet ; the slender side roots were unaffected. The presence of the parasite destroyed many of the plants ; others were dwarfed and showed brown, sunken areas in the root-neck ; the plants above ground withered very soon.

A. L. S.

Endoconidia of a Sclerotium.—M. FOEX and M. ROSELLA (" Sur une forme endoconidienne accompagnant un sclérote constitué dans un épi de Blé," *Bull. Soc. Mycol., France*, 1928, 44, 349–59, 10 text-figs.). A violet-coloured grain of corn was found in Seine-et-Marne and was examined by the authors. It was a form of hard sclerotium with mycelium on the surface, bearing conidia in a rayed series resembling asci. In addition, conidia were found in the interior of hyphæ rising above the others. These latter hyphæ tend to disappear, but the endoconidia retain their alignment for some time. Cultures were made on a series of artificial media, and the resulting growths are described. Both exogenous and endogenous conidia were developed, especially on liquid media. They resembled those originally found on the corn-grain. A discussion follows on the systematic relation of the unusual sclerotium. Finally the authors consider they are probably dealing with an endoconidial form of the *Sphacelia* of *Claviceps purpurea*.

A. L. S.

New Discomycetes.—J. GRELET and A. DE CROZALS (" Discomycètes nouveaux 3^e série," *Bull. Soc. Mycol., France*, 1928, 44, 336–90, 1 pl.). A series of minute Discomycetes new to science are described. They were collected by de Crozals from Southern France—Haute Savoie, Toulon, etc. Notes of affinities are added. A note is also appended on *Stenocybe bryophila* Watson, which had been received by de Crozals from S. M. Macvicar, but not recognised as specifically

new; it grows on the stalks of various hepatics. Macvicar's specimen was collected in West Inverness in 1903; Watson's, near Llanberis, Wales, in 1924. Microscopic characters of the new species are delineated on the plates. A. L. S.

Study of Erysiphe.—PANCA EFTIMIU ("Contribution à l'étude de l'évolution nucléaire chez certains Erysiphacées," *Bull. Soc. Bot., France*, 1929, 10, 10-20, 2 pls.). A sketch is given by the author of the differences of opinion with regard to nuclear sexual fusion in *Erysiphe*, a genus on which important research was done by Harper and Dangeard, who differed in their conclusions. The methods of staining, etc., used in the research are given, and the development of the fruiting body from the conidial to the sexual stage is followed. The author describes the ascogonium as filled with dense protoplasm, the antheridium, or trophogonium, as almost empty. The latter becomes bicellular, cutting off a small apical cell, and the nucleus degenerates. The ascogonium is unicellular with one or two nuclei. Further development is described of the sexual cells and of their nuclei with the formation of asci and perithecia. Summarising the whole, Eftimiu states that the ascogonium is at no stage in contact with the trophogonium, and at that early stage there is no fertilisation process, thus contradicting Harper's conclusions. After fusion of the two nuclei in ascus formation there is only one reduction-division in the first mitosis in the ascus with four chromosomes. The diploid condition, with eight chromosomes, appears only after nuclear fusion; the haploid reappears with the first mitosis. A. L. S.

Tabulation of Alternaria and Macrosporium.—P. A. YOUNG (*Mycologia*, 1929, 21, 155-66). The author has made a comparative study of these two genera as described in literature. He inclines to the view that *Macrosporium* as a generic name is redundant, and that all the species should be classified either as *Alternaria* or *Stemphylium*. The fungi were grown in cultures, and careful measurements were made of the spores by Young, who has tabulated his results—a very long series. A. L. S.

Rust Infection.—G. GASSNER and W. STRAIB ("Untersuchungen über die Abhängigkeit des Infektionsverhaltens der Getreiderostpilze vom Kohlensäuregehalt der Luft," *Phytopath. Zeitschr.*, 1929, 1, 1-30, 1 col. pl., 1 text-fig.). The paper gives in detail the research undertaken to test the influence of the carbon-dioxide content of the atmosphere on the development of rusts on cereals. Experiments were made with five different species of rust on young plants enclosed in a chamber through which was passed different currents of carbon-dioxide. These experiments, described in detail, left no doubt that the growth of the rust after infection was considerably influenced by the presence or absence of the gas. If CO₂ were entirely lacking, no infection could take place, and a too small quantity also retarded the growth of the fungus. The normal content of the air was sufficient to induce a high degree of growth, which might be further enhanced by an increase of the dioxide. In resistant grasses infection took place more easily, and the discolouration of the leaves was more marked. Too great supplies, however, hindered the process, and instead of rust pustules there was only a discolouration of the leaves at the point of infection. Other observations were made as to the limits of gas content that were favourable or unfavourable to infection. The significance of the effect of the dioxide lies in its influence on assimilation and the carbon nourishment of the green cells in the host-plant, which is distinctly heightened by an increased supply, whereas too large a surplus is a disadvantage to the healthy development both of the host and the parasite, owing to the formation of harmful products. The plate

represents colour changes due to different amounts of the gas. A list of papers dealing with the physiology of parasites is appended. A. L. S.

Pycnidia of the Rust Fungi.—W. B. GROVE (*New Phytologist*, 1929, 28, 162-4). Grove notes the importance of Craigie's work on uredineal pycnidia, pronouncing it a "far-reaching discovery." As there is difficulty in securing separate sporidia with certainty, he has suggested a method that might prove to be practicable in further research. He catches teleutospores on a gelatine film by tapping the rust specimen over the petri-dish, causing the mature spores to drop. If sufficiently sparse, the isolated spores, on germination, scatter their sporidia within a short distance round the spore and can be easily identified. These four sporidia might be used to inoculate a host-leaf and thereafter produce pycnidia. It would thus be possible, by subsequent inoculation, to decide the + or - character of each sporidium and accurately follow their development. A. L. S.

New *Mycotorula*.—PIERA SCARAMELLA ("Ricerche preliminari su una nuova forma de '*Mycotorula*' a pigmente rosa-rossa," *Nuovo Giorn. Bot., Ital.*, 1929, 35, 546-54, 1 text-fig.). It was while isolating *Penicillium* from the fructification of *Phyllodendron* that some *Torulopsidaceae* were found, and among them a species referred by the author to *Mycotorula*. Many experiments were made by cultures to determine the most favourable substratum, its action on sugars, animals, etc. A figure is given of the hyphæ-bearing conidia and of these conidia in the process of budding. It formed in all the cultures a red pigment insoluble in alcohol. It seemed to cause little effect on animals. Finally Scaramella decided that he was dealing with a new species, which is described as *Mycotorula roseo-corallina*.

A. L. S.

Study of *Ramularia*.—CH. KILLIAN ("Nouvelles contributions à l'étude biologique du genre *Ramularia*. Sur deux *Ramularia* parasites des *Veronica*," *Bull. Soc. Mycol., France*, 1928, 44, 317-25, 2 pls.). Killian has drawn attention to the different types of overwintering in species of the leaf parasite *Ramularia*. *Ramularia coccinea* grows on *Veronica officinalis*, and as certain leaves of the host persist during the winter, the fungus maintains existence on these without the necessity of forming "organs of conservation." Another species, *Ramularia Veronica cymbalariae* n. sp., grows on an annual plant in Algiers, the leaves and stems of which disappear in the dry summer season. In this species the mycelium forms brown masses, with numerous sclerotia in the infected tissues. Later appear pycnidia and minute pycnidiospores. The various species on *Veronica* bear considerable resemblance to each other, but the fungus adapts itself to the life conditions of the host-plants.

A. L. S.

Research on *Fusarium*.—C. C. HARVEY ("Studies in the genus *Fusarium*. VII. On the Different Degrees of Parasitic Activity shown by Various Strains of *Fusarium fructigenum*," *Ann. Bot.*, 1929 43, 245-59). The experiments described in the paper were carried out with the various strains of *Fusarium fructigenum* which are parasitic on apple fruit. Harvey distinguishes Brown's four morphological types—(1) mycelial type, with strong development of aerial mycelium and reduced sporulation; (2) sporodochial type, characterised by pustules of spores; (3) pionnotal type, with a continuous layer or slime of spores; and (4) long-spore type, resembling the previous type, with a thinner layer of spores having a high degree of septation. Artificial cultures are described and inoculation experiments of many kinds of apples. Harvey determined four grades of parasitic virulence correlated in a general way with the type strains. The most virulent attacks were

with (2), the mycelial strain, in declining order—the sporodochial, the pionnotal, and the long-spore types. The activity of the strain appears to be independent of the quantity of inoculum used (sporal or mycelial) and of the physiological state of the inoculum, such as the presence of reserve food material in the spores, etc.

A. L. S.

Comparative Study of *Fusarium*.—JULIAN H. MITTER ("Studies in the genus *Fusarium*. VII. Saltation in the Section *Discolor*," *Ann. Bot.*, 1929, 43, 379–410, 2 pls., 12 text-figs.). Mitter begins with a comparative account of growth in the section of *Fusarium*—the mycelial development, rate of radial advance, colouring, sporing and spore characters. The substratal colouring varied in the different groups as wine-coloured, carmine, pink, yellow, orange, brown or brick-red. The spores varied in size and septation. Several saltants were noted during the course of the work; their mode of origin with their morphological characters are described. It was found that these saltants possessed characters, such as substratal colouring, spore characters, etc., belonging to different groups. Ten of the "Discolor" strains and saltants were found to be capable of causing decay in the Cox's orange pippin variety of apple. The strains generally differed in virulence, and the saltants were less virulent than the parent strains.

A. L. S.

Hydnaceæ.—HOWARD J. BANKER ("Notes on the Hydnaceæ" *Mycologia*, 1929, 21, 145–50). The writer has selected resupinate Hydnaceæ for this study and chiefly the genus *Odontia* Pers., as exemplified by *O. ferruginea*. He gives a historical and descriptive account of this monotypic genus.

A. L. S.

Russulæ.—M. JOSSERAND ("A propos de *Russula xerampelina* et de *R. fusca*," *Bull. Soc. Mycol., France*, 1928, 44, 343–7). The authors challenge the statement that the polymorphous species *Russula xerampelina* includes also *R. fusca*. They rely on two characters—the microscopic appearance of the spores, echinulate in *Russula xerampelina* but feebly marked in *R. fusca*, and the chemical reactions, which are totally different in the two forms. It is allowed that there is a brown form of *R. xerampelina*, but that there is also a true *R. fusca*.

A. L. S.

***Amanitopsis crocea*.**—V. MELZER ("Note sur *Amanitopsis crocea* Qu.," *Bull. Soc. Mycol., France*, 1928, 44, 341–2). In this note Melzer records the action of phenol (2–3 p.c. in a water solution) on the tissues of certain agarics. He distinguishes three different reactions: (1) negative; (2) a brown colouration after about 10 minutes, becoming usually chocolate-brown, indicated by him as the normal reaction; (3) a red tinge in 1 or 2 minutes, becoming finally dark purple. His interest was aroused by finding specimens growing along with *A. vaginata* that were yellow in colour and become red with phenol, while the true *A. vaginata* became brown. He concludes that he is dealing with two distinct species.

A. L. S.

***Lentinus variabilis*.**—R. KUHNER ("Notes sur le *Lentinus variabilis*," *Bull. Soc. Mycol., France*, 1928, 44, 331–5, 1 pl.). Kuhnér gives an anatomical and cytological study of this fungus in order to obtain some light on its affinities. He notes the very dense growth of the tissues, formed at first of slender but later with very thick-walled hyphæ. The gills also present the same dense tissues; the hymenium develops from the base towards the summit of the gill. The main interest lies in the cytological study: the basidium, filiform at first, contains two nuclei, which unite, the united nucleus increasing in size to the width of the basidium. Two transversal divisions occur, and certainly with more than two chromosomes. The four nuclei pass into the sterigmata and then into the spores. If a second division should have taken place, the four extra nuclei are left behind in

the basidium. The spore is binucleate, owing to mitosis of the nucleus before the dropping of the spore. Stress is laid on the fact of the transversal divisions of the basidial nuclei, as *Lentinus* is thus differentiated from *Cantharellus*, where the divisions are longitudinal. Kuhner concludes that *Lentinus* is related to the higher polypores, especially to *Melanopus squamosus*. A. L. S.

Notes on the Larger Fungi.—G. POIX (I. "*Volvaria gloiocephala* et *Volvaria speciosa*," *Bull. Soc. Mycol., France*, 1928, 44, 360-4). The author has questioned the identity of these two species. An abundant crop of the first-mentioned on a sandy soil enabled him to make and record exact observations at each stage of growth. Similar studies were made on *V. speciosa*. The two species differ in the rose colour of the gills, which appears at a late stage in *V. gloiocephala*, but early in *V. speciosa*. There are other differences in the form of the pileus. II. "*Psalliota campestris* et sa variété *praticola*." Poix found the species and variety differing in several particulars—in the colour of the gills (never rose in *praticola*), its very short stalk, and the more flattened pileus. He considers the differences to be almost specific. A. L. S.

Lactarius subalpinus n. sp.—R. KURNER (*Tom. cit.*, 379, 1 col. pl.). The author has given a diagnosis of the species depicted on the plate. It was found in troops in Savoy, clear orange in colour and tomentose, with a fruity odour, mild in taste, becoming hot. Stalk also tomentose. A. L. S.

Notes on Armillaria mellea.—L. LUTZ ("Sur l'*Armillaria mellea* en culture artificielle," *Bull. Soc. Mycol., France*, 1928, 44, 326-7). Lutz found that rhizomorphs of *Armillaria* were freely formed in artificial cultures. They were white at the tips, but brown further back. Carpophores were not formed. Luminescence appeared in the rhizomorphs at the browning stage. A. L. S.

Notes on Polyporus betulina.—L. LUTZ ("Sur l'influence exercée par le support sur les caractères morphologiques du Polypore du Bouleau. Contribution à l'étude du tanin anti-oxygène," (*Tom. cit.*, 328-30, 1 text-fig.). Lutz has noted that the relation of the parent to the host-plant is largely influenced by the presence in the host of certain substances. Thus *Polyporus betulina* grows on the birch, but not on the oak, the latter containing tannin. Lutz, by repeated washings, deprived an oak slice of the bulk of its tannin content, and was thereafter able to grow on the cleansed wood the first stages of the birch polypore. There was, however, a continual recurrence of brown colouration on the different growths, due, he considers, to the tannin that still remained in the tissues of the oak. A. L. S.

Tuckahoes in Florida.—GEORGE F. WEBER ("The Occurrence of Tuckahoes and *Poria Cocos* in Florida," *Mycologia*, 1929, 21, 113-30, 1 pl., 5 text-figs.). The term "tuckahoes" refers to certain underground structures that were used as bread by the American Indians. A large number of plants, or parts of plants, are included, mostly bulbs and roots which are known as "earth-nuts," "wild onions," tuberous roots, etc. In 1762 Clayton classified certain of these tuckahoes of fungus origin as *Lycoperdon solidum*. Macbride, in 1817, listed them as *Sclerotium*, and Schweinitz, in 1822, added the specific name *cocos*. They attain to quite considerable size and weight (up to 22½ lbs.). The fungus develops on the roots of trees—magnolia, citrus, quercus, eucalyptus, etc. For long the fructification was unknown, but by successful cultures the hymenia of a *Poria* were at length developed, and the name *Poria Cocos* Wolf has been established. Most of the fungous tuckahoes have been found in sandy soil, and dissemination is probably brought about by

insects, etc. They are not of high food value, as starch is absent; pectin is abundant. A long list of literature is given. A. L. S.

Phalloids of Surinam.—ED. FISCHER ("Untersuchungen über Phalloideen aus Surinam," *Festschrift Hans Schinz, Zurich, Beer & Co.*, 1928, 1-39, 2 pls., 7 text-figs.). Fischer states that, though the fungus flora of English, French, and Dutch Guiana has been well studied, only little is known as to the Phalloids of that region. The earliest record, *Dictyophora indusiata* Pers., is by Ventenat, in 1798, from the mouth of the Surinam River. A collection by Professor G. Stahel of fungi from Surinam was recently submitted to Fischer, among them a number of fine Phalloids. Many of these were already known, but a few were new to science and have been now described. They belong to two families—Clathraceæ and Phallaceæ. Detailed accounts are given of four species of the first family and comparisons drawn between them and other forms. In that family a great deal depends on the form and development of the "arms." Under Phallaceæ five species are considered, among them the beautiful *Dictyophora indusiata*, which was described by Ventenat from Dutch Guiana near to the sea and the River Surinam, and which has been found at the same place. *Dictyophora phalloidea* f. *Farlowii* has been given specific rank on account of the character of the "veil." A. L. S.

Ancient Carving of a Toadstool.—JOHN W. HARSHBERGER ("An Ancient Roman Toadstool Carved in Stone," *Mycologia*, 1929, 21, 143-4, 1 fig.). The writer, whose lamented death occurred recently, visited, in July, 1928, the ruins of the ancient Roman city of Timgad, in Algeria. The ruins were found to possess much interest, and Harshberger found that the colonnades were decorated with carvings—one block with a scroll of grape vines and bunches of grapes, another by a design of *Acanthus* leaves surrounding a central stone toadstool carved so that the upturned gills and the stipe are well shown, possibly of some poisonous species, and probably the earliest known representation of a gill-bearing fungus. It dates back to the second century. A. L. S.

Fungi from Cambodia.—FERNAND MOREAU ("Contribution à l'étude de la flore mycologique du Cambodge," *Ann. Crypt. exot.*, 1929, 2, 59-65). The mycological flora of Cambodia has been little studied hitherto. The species recorded in this paper were collected in the northern and western districts, in the vicinity of Siam. They are all, or nearly all, new for Cambodia. The fungi recorded are mostly the more leathery and harder forms of *Polyporus*, *Stereum*, *Microporus*, *Trametes*, etc. Descriptive biological notes are given along with exact localities. A. L. S.

Spanish Microfungi.—P. LUIS M. UNAMUNO ("Nuevos datos para el estudio de los hongos parasitos y saprofitos de los alrededores de Durango (Viscaya)," *Bol. Real Soc. Esp. Hist. Nat.*, 1929, 29, 113-25, 4 text-figs.). This contribution to the fungal flora of Spain amounts to 74 species. They were collected in the neighbourhood of Durango. Seventeen species were found to be Uredineal, and therefore parasitic, a few were Ascomycetes, but the larger number were Deuteromycetes—Sphærospideæ and Hyphomycetes. Of these, 21 species were new to Spain, among them *Epicoccum neglectum*, parasitic on the uredosori of *Puccinia glumarum*. Two species of Ascomycetes and 4 of Sphærospideæ were found to be new to science. These are described and figured. A. L. S.

Michigan Fungi.—ALFRED H. POVAH ("Some Non-Vascular Cryptogams from Vermilion, Chippewa County, Michigan," *Mich. Acad. Sci., Arts and Letters*, 1928 (1929), 9, 253-268). This collection of cryptogams was made as part of a

geological and biological survey of the north-eastern part of the State of Michigan. The region includes virgin forest, more recent forests, spruce cedar swamp, sand dunes, etc. A fairly long list of fungi of all classes has been recorded, although the season was a dry one. Several rare specimens of American fungi were found. Most of them are, however, of world-wide distribution. Habitats are carefully noted.

A. L. S.

Japanese Fungi.—SEÜCHI KAWAMURA ("On Some New Japanese Fungi," *Jap. Journ. Bot.*, 1929, 4, 291–302, 1 pl., 22 text-figs.). The author has described a new fungus which grows over the surface of the bamboo. A somewhat similar fungus had been previously described by him. When the fungus was removed and the culm dried and polished, discoloured areas were left, and the variegated bamboo, called tiger-figured bamboo (Torafudake), was used to make ornamental brush handles, pipes, etc. Kawamura has found another somewhat similar growth on the bamboo, which he designates as panther-figured, the pattern produced being that of a large dark area with smaller darker spots. It grows on a different bamboo, and examination proved it to be a new species of the previously described genus of Sphæriaceæ *Miyoshia*—now, however, altered to *Miyoshiella*. The new fungus *M. macrospora* is described and figured. A note is added on another undetermined fungus which induces "Chinese-figured bamboo." Kawamura also describes a fungus which attacks an earth-spider, *Pachytomerus fragaria*. The body of the spider is completely enclosed in the mycelium, which appears early in June. Other new fungi are *Mutinus coracordes*, which differs in form and colour (pale rose and white) from the known species; and *Geoglossum rotundiformis*, with a round, compressed ascophore of flattened tadpole shape. The new species are figured in colours.

A. L. S.

Vegetable Cytology.—M. GUILLIERMOND ("Nouvelles remarques sur l'appareil de Golgi: l'appareil de Golgi dans les levures," *Compt. rend. Acad. Sci., Paris*, 1929, 188, 1003–6, 22 text-figs.). Guilliermond has tested on yeasts his previously published view on the "Golgi apparatus"—that it is associated with the vacuole, and not, as some have asserted, independent both of the chondriome and the vacuole. In the yeast cell, by skilful colouration, the chondriome is seen to be represented by long wavy chondriocontes. By the silver methods of Da Fano and Golgi it is possible to demonstrate the presence of intravacuolar bodies (metachromatic). Similar results have been obtained in the filaments of *Oidium lactis* and *Ashbya Gossypii*, though colour impregnation differs from one filament to another. Sometimes the chondriome is a wavy line; at other times the lines are swollen at intervals into vesicles.

A. L. S.

Tuberisation of Plants.—CARLOS SPEGAZZINI ("Casos de tuberizacion," *Physis, Rev. Soc. Arg. Cienc. Nat., Buenos Aires*, 1925–1927, 8, 121–5. See *Bot. Centrabl.*, 1929, 156, 181–2). The author describes "parasitic tuberisation on *Nicotiana longiflora* due to the mycelium of *Peronospora Nicotianæ*. It causes swellings on the hypocotyl or on the root. These may swell from the normal 5–7 mm. to about 10 or even to 20 mm. The surface of the lumps is of a fleshy consistence and yellow colour, at first smooth, later lined and warted. The fungus hyphæ spread between the cells of the cortex. Similar growths were examined on species of *Amaranthus* caused by *Cystopus Blüti*, and on *Solanum* spp. by an undetermined fungus.

A. L. S.

Staining Methods.—K. ST. G. CARTWRIGHT ("A Satisfactory Method of Staining Fungal Mycelium," *Ann. Bot.*, 1929, 43, 412–13). After repeated experi-

ments on staining mycelial filaments in woody tissues, the writer has found that the best results are given by a combination of safranin, which stains the lignified walls, and picro-aniline blue, which stains the fungal hyphæ. The procedure recommended is to stain lightly and quickly with aqueous safranin wash, and stain in saturated aqueous solution 25 cc. aniline blue and 100 cc. picric acid. Warm section and stain, then wash in water, finally in absolute alcohol and clove oil, and mount in Canada balsam. The method has been tested with a large number of wood-attacking fungi—Basidiomycetes, Ascomycetes, Fungi Imperfecti and "Moulds."

A. L. S.

Biochemistry of Potato Disease.—ELMAR LEPIK ("Untersuchungen über den Biochemismus der Kartoffelfäulen," *Phytopath. Zeitschr.*, 1929, 1, 49–102, 15 text-figs.). The results of chemical study of the reserve bodies in the potato tuber are here set forth in great detail. It was found that the disease in the tuber was not connected with the chemical condition nor with the water content. The development of the fungus was aided by the presence of oxygen, and was inhibited when air was cut off. As to the results, it was found that there was an increase in the tested substance of the diseased tuber by quantities of pentosane, methylpentosane, and raw fibres, with a lowering of the dry content. Along with that there was an alkaline reaction. Starch grains, which amount to about 70 p.c. of the dry substance, were only affected at later stages of the disease, when they showed corrosion and a continuous dissolution. The fungus was intercellular and destroyed the middle lamella of the cells. It was confined to the outer layers of the tuber at the outset of the infection; only at late stages did it reach the centre. Attention has been given to the normal chemical changes within the tuber—as, for instance, the conversion of starch to sugar by the enzyme, amylase—more active in the later stages or the resting period. There is a comprehensive list of the literature (154 numbers) dealing with every aspect of the subject.

A. L. S.

Resistance Inheritance in Oats.—GEORGE M. REED ("The Inheritance of Resistance of Oat Hybrids to Loose and Covered Smut," *Ann. N.Y. Acad. Sci.*, 1928, 30, 129–76). The aim of the research was to find a hybrid oat that would not be infected by smut. One of the great difficulties is to avoid undesirable inheritance features, even though resistance is achieved. Hull-less and Black Mesdag oats were crossed, and experiments made with the F_2 and F_3 generations. Hull-less oats are susceptible to both smuts, while Black Mesdag is resistant. True breeding selections of Hull-less oats which possess the marked resistance of the original Black Mesdag have been obtained. It is hoped that recombination of smut resistance with various desirable characters, such as quality of grain, cropping capacity, etc., may be secured. The various crossings and subsequent infections are listed in tables, with the number and percentages of infections.

A. L. S.

Fungi on *Pachysandra*.—W. G. HUTCHINSON ("An Undescribed Species of *Macrophoma* and of *Volutella* occurring on *Pachysandra terminalis*," *Mycologia*, 1929, 21, 131–42, 4 text-figs.). The host-plants sent from Virginia were found to be infected with species of *Macrophoma* and *Volutella*. The *Macrophoma* formed small black pustules on the dead stems. Examination by means of cultures, inoculations, etc., proved that the fungus was a saprophyte. No perfect stage was found, and it is listed as *M. Pachysandræ* n. sp. The study of *Volutella* proved that it was a wound parasite producing a diseased condition in the stems and sometimes in the leaves of the host. The mycelium is intracellular, living within the cells of the epidermis and cortex, and giving rise to brown spots on the leaves and to

constrictions on the stem. This fungus was also determined to be new to science as *Volutella Pachysandracæ*.
A. L. S.

Discolouration of Cucumbers.—H. KLEBAHN ("Vergilbende junge Treibgurken, ein darauf gefundenes Cephalosporium und dessen Schlauchfruchte," *Phytopath. Zeitschr.*, 1929, 1, 31-44, 10 text-figs.). The chief aim of the writer was to discover the cause of the yellowing of young cucumbers in the culture frames. Examination showed frequently a growth of fungi on the yellowing spots, and one of the most frequent, a Hyphomycete, *Cephalosporium* sp. A thorough test was made as to its parasitism and as to its vital connection with the diseased areas. It was found that infection by the fungus induced a similar discolouration; it was also proved that yellow spots occurred quite independently of the fungus, though there was also proof that the fungus was truly parasitic and caused yellowing. Spraying the young plants with weak Bordeaux mixture gave no light on the problem. A study of the fungus was undertaken by means of artificial cultures, on which it developed easily. Perithecia were developed and mature spores produced. Klebahn has seen cause to describe it as a new genus and species, *Plectosphaerella cucumeris*.
A. L. S.

Cotton Disease.—G. S. KULKARNI and B. B. MUNDKUR, introduction by HAROLD H. MANN ("Studies in the Wilt Disease of Cotton in the Bombay Karnatak," *Mem. Dept. Agric., India*, 1928, 17, 7-27, 4 pls.) The fungus of the cotton disease, or that most frequently associated with it, is a species of *Fusarium* morphologically identical with one discovered in Alabama in 1892. It was found that the *Fusarium* was a definite parasite of certain varieties and strains of the cotton plant, and caused the death of the host. The authors then take up the question of the effect of the fungus on the host-tissues; the primary factor is not the plugging of the vascular ducts. Cuttings of cotton plants were placed in filtrates made from the fungus, the methods being carefully described. It was found that the filtrates had an immediate toxic effect. The harmful agent is evidently a toxine, but its nature has not been determined.
A. L. S.

Fungal Infections.—ALEXANDER BUCHHEIM ("Infektionsversuche mit *Erysiphe Polygoni* auf *Caragana arborescens*," *Ber. Deutsch. Bot. Gesell.*, 1929, 47, 226-9, 1 text-fig.). Buchheim had already proved that *Erysiphe Polygoni* infected many species of *Caragana*. Further experiments on *Caragana* and other plants have proved that the fungus is largely confined to species of *Caragana*, but that it also attacks *Robinia pseudacacia*.
A. L. S.

Clover Disease.—N. L. ALCOCK and M. S. MARTIN ("A Seed-Borne Disease of Clover, *Trifolium repens*," *Trans. and Proc. Bot. Soc., Edin.*, 1928, 30, 13-18). The authors detected diseased grains in a consignment of wild white clover seed from Central Europe and from New Zealand. Certain grains in the packets were characterised by a peculiar grey-pink colour due to a mycelium on the seed-coats; brown depressed areas were also present. The superficial hyphæ were washed off with mercuric chloride and the seeds placed on culture media. The mycelium beneath the seed-coat grew out and formed small sclerotia, becoming dark in colour. From the sclerotia were developed small dark processes, and at the tips of these pinkish-brown apothecial cups. The fungus was identified as *Sclerotinia trifoliorum*, though the apothecia were smaller than type size.
A. L. S.

Disease Control.—E. E. EDWARDS ("The Control of a Serious Potato Trouble," *Journ. Agric.*, 1929, 36, 234-42, 2 pls.). The soil in which the potatoes

grew was heavily infested with eelworm and with the fungus *Corticium Solani*. Where the roots and rhizomes were badly damaged with eelworm, the stems were attacked by the fungus. Edwards gives an account of the various chemicals used to disinfect the soil—creosote salts, carbon disulphide, calcium cyanide, and quicklime. On the whole the creosote treatment (a crude form of naphthalene) gave the best results. A comparative table sets out the comparative cost of treatment and increase of crop for the various experiments. A. L. S.

Pathogenic Monilia.—J. McA. KATER ("Note on the Structure of a Monilia Isolated from a Case of Psoriasis," *Univ. Calif. Publ.*, 1928, 14, 301–6, 1 pl., 1 text-fig.). The author had made a previous cytological study of *Saccharomyces cerevisiae*, and had proved that nuclear division in the yeast cells at the time of bud formation was by mitosis. The present note is an extension of that study to an account of *Monilia psilosis* from the skin of a patient. Cultures were made and the *Monilia* formed yeast-like cells—round, oval or elongate. After the second day mycelial forms appear—at first straight filaments, later branches from apical buds. The cells of rapidly growing cultures are uninucleate, with numerous metachromatic granules. In older stages a vacuole sometimes appears. In budding, the young cells break away when they are small; chains of cells seldom arise. The cells of the filaments are uninucleate, except the terminal cell, which may contain four nuclei, but the partitions of the terminal cell into four spores has not been observed. This tetranucleate condition suggests ascospore formation, and, if that were proved, the organism would be classified under *Endomyces*. Nuclear division seems to be by mitosis, though this has not been entirely proved. A. L. S.

Study of Soil Bacteria.—M. DUGGELI ("Studien über den Einfluss von Rohhumus auf die Bakterienflora der Boden," *Festschrift Hans Schinz, Zürich*, 1928, 306–33, 7 tables). The author devotes several pages to a general account of soil conditions and the effect of the organic humus material on the inorganic soil—sand is bound together by the humus of plant remains, whereas clay soil is broken up, etc. He passes on to study the relation between the presence of humus and its effect on the microflora and fauna. Without the microflora the soil would be hopelessly cumbered with humus, the destruction of which is necessary to the cycle of life in field and forest; and where it accumulates, the forester or farmer must use means to break it up by letting in light and air, by adding lime, and by planting grasses such as *Molinia caerulea*, etc. Samples of humus were tested for bacteria—the different kinds and the numbers per sample. The research on these is fully explained, and the results are set out in a series of tables giving the nature and composition of the humus and the plants that grew on the different samples. The results are comprised in a summary. It was found that samples from alpine and sub-alpine zones were relatively poor in bacteria, but there was a considerable increase of them in well-manured soil. With an increase of acidity there was also a falling off in numbers, though that factor alone was not solely important, as aeration, water, heat, etc., also played their part. Again, it was found that where earthworms were abundant there was a larger quantity of Schizomycetes. Macroscopically, the presence of earthworms could be detected by the darker colour of the soil masses. In none of the samples tested were found nitrifying bacteria of the type of *Azotobacter chroococcum*, and the anærobic cellulose destroying organisms were also absent, or if present, in very small quantities. A. L. S.

Medical Mycology.—ALDO CASTELLANI ("Fungi and Fungous Diseases," *Amer. Med. Ass., Chicago, Illinois*, 1927–28, 1–203, 91 text-figs. and plates). There are published, here, three lectures—on "Fungi," on "Fungous Diseases," and on

"Skin Diseases Due to Fungi"—which were delivered by Castellani at the University of Illinois College of Medicine in March, 1926. The author notes that fungi as agents of disease were recognised long before bacteria; as a parasite on man the first was described by Langenbeck in 1839—the thrush-fungus. Other discoveries followed in slow succession. Castellani opens his discourses by an account of these, and by an account of fungi generally, and especially of their classification. Many of the lower fungi and the Fungi Imperfecti have been mistaken for bacteria, so closely are they associated in appearance. The first hundred pages are given up to an account of all these minute fungi, chiefly when parasitic, their life-histories, biology, and relationships. The second lecture takes up the various diseases in animals and men due to fungi, describing the symptoms and characters of the fungus growths as well as the particular organisms involved; among these the well-known thrush and such accidental troubles as tea-taster's cough, due to a *monilia* fungus which often occurs in tea-dust. Lecture III. (pp. 140–195) is devoted to hair and skin diseases, i.e. to external fungus attacks. The fungi causing them are described, as well as the disease, and in each case suitable treatment is indicated. A bibliography and a copious index are supplied. A. L. S.

Serological Investigation of Bacteria.—GEO. K. K. LINK and W. H. TALIAFERRO ("Further Agglutination Tests with Bacterial Plant Pathogens," *Contrib. Hull Bot. Lab., Bot. Gaz.*, 1928, 85, 178–97). The serological experiments here explained were made on plant bacteria: *Bacterium campestre*; *Bact. phaseoli* group; *Bact. Medicaginis* var. *phaseolicola*, and *Bact. tumefaciens*. It had been stated that it was possible to differentiate and determine these plant bacteria by agglutination methods. The bacterial diseases thus dealt with were black rot of crucifers (*Bact. campestre*); blight of beans (*Bact. phaseoli*); citrus canker (*Bact. citri*), and many others. The methods and experiments are set forth at length, and proof has been gained that these agglutination tests can be used in many cases, not only to differentiate, but to discover affinities between different organisms. A. L. S.

Further Bacterial Tests.—GEO. K. K. LINK and W. H. TALIAFERRO (*Tom. cit.*, 198–207). These further tests were carried out on the soft-rot group of plant pathogens—*Bacillus aroideæ* and *B. carotovorus*. Extensive studies had been made on the group, not only on the above two species, but also on *B. oleraceæ* and *B. omnivorus*. As a result of these experiments, agglutination tests have sufficed to differentiate the soft-rot group from *Bacterium campestre*, and the *phaseoli* group from *Bact. medicaginis* var. *phaseolicola*, and from *Bact. tumefaciens*. Serologically, *B. aroideæ* and *B. carotovorus* are distinct, though closely related, and their maintenance as distinct species is justified. A. L. S.

Japanese Myxobacteria.—ATSUSHI WATANABE and ISUKE LANAKA ("Notiz ueber eine Myxobakterie," *Bot. Mag., Tokio*, 1929, 43, 227–32, 1 pl.). The authors, by cultures and by microscopical examination, have identified *Chondromyces lanuginosus*, of which they give a full description along with a photographic plate. Two species only (*Myxococcus virescens* and *M. rubescens*) had previously been recorded for Japan. The authors give, in addition, a list of all papers dealing with Myxobacteria, 39 numbers. A. L. S.

Lichens.

Roccella Species.—M. CHOISY ("Quelques Roccella nouveaux," *Ann. Crypt. exot.*, 1929, 2, 66–8, 1 pl.). The new species described grew on trees in Zanzibar or Madagascar and are in the herbarium of J. Ph. Becker at Lyons.

R. applanata n. sp. resembles *R. montagnei*, but with smaller asci and spores; *R. endocrocea* n. sp. is distinguished by the saffron-yellow colour of the medulla; *R. intermedia* n. sp. is nearly related to the latter, but the yellow colouration is confined to the base of the apothecia; these two species were intermingled on the same trunk.

A. L. S.

Italian Lichens.—E. MAMELI-CALVINO and A. AGOSTINI ("Secondo contributo alla Lichenologia del Forlivese," *Nuovo Giorn. Bot. Ital.*, 1929, **35**, 525–35). The author gives a sketch-history of lichen collecting in the part of Italy on the Adriatic coast to the north. It includes the pine woods of Ravenna, the valleys of the rivers Montone, Rabbi, Ronco, and Savio from their source, and some territory still further south. Jatta's *Flora Italica* has been followed, and too much attention has not been paid to "varietal" forms. About 81 species have been added to previous lists. A very varied number of lichens were collected. Occasional biological notes are added.

A. L. S.

North Polar Lichens.—BERNT LYNGE ("Lichens from the Taimir Peninsula. Norwegian North Polar Expedition with the 'Maud,' 1918–25," *Scientific Results, Geofysisk Inst., Bergen*, 1929, **5**, n. 1, 11–15, 1 map). Bernt Lynge has published in one paper both the vascular plants and lichens. These latter were not collected as such, but an examination of the stones brought back for geological purposes produced 45 species. Many of them were extremely reduced as regards the thallus, all of them were Arctic plants, one of the commonest *Parmelia minuscula*, with its intricately branched filamentous lobes. One new species, *Buellia arctica*, is described, the colour of the thallus almost as in *Rhizocarpon geographicum*. The latter plant was brought from nine localities, while *Gyrophora proboscidea*, a common species in Arctic regions, was found in seven.

A. L. S.

Swedish Lichens.—A. H. MAGNUSSON ("New or Interesting Swedish Lichens, V," *Bot. Not.*, 1929, 110–22). The first series of novelties consists of forms of *Cladonia subcervicornis*, a common species in the neighbourhood of Göteborg. Magnusson has described six forms, of which four are new. They differ chiefly in the podetial squamules or phyllocladia. He also gives new species or forms of *Lecanora* and *Lecidea*, with very full descriptive notes.

A. L. S.

Russian Lichens.—A. N. OXNER ("Neue für U.d.S.S.R. und seltene Flechtenarten," *Ukrainian Bot. Rev.*, 1928, **4**, 51–6, Russian with German *résumé*). The author notes, in connection with *Ramalina asahiniana* Zahlbr., that the so-called soredia are merely a bursting of the thallus, and he records for *Cetraria collata* a large development of isidia, thus constituting, in his view, a new form.

A. L. S.

Ukraine Lichens.—A. N. OXNER ("Neue für die Ukraine Flechtenarten," *Bull. Jard. Bot., Kieff*, 1928, **7–8**, 71–3, Russian with German *résumé*). The author is continually adding to his accounts of lichens in the Ukraine. A number of those listed, such as *Collema tenax*, are familiar British forms. He records *Theloschistes brevior* f. *halophyla* as new to science.

A. L. S.

South American Lichens.—G. O. MALME ("Pyrenulæ et Anthracothecia Herbarii Regnelliani," *Ark. för Bot.*, 1929, **22**, n. 11, 1–40, 3 text-figs.). Many species of *Pyrenula* and *Anthracothecium* have been reported from Brazil, but few specimens exist in herbaria. Malme, however, finds that both of these genera are abundant, individuals as well as species. The difficulty of their determination is

partly owing to the literature being scattered through many periodicals and books. The thallus is hyphophlœodal, and the bark on which these lichens grow exercises great influence on the outward appearance of the lichen. Spores—their form, size, and septation—are very important as specific characters. Almost always the perithecium contains minute oil drops, which probably secure a longer period of spore persistence and germination. Frequently the spores have a gelatinous wall (halonate), probably of service in causing the spores to adhere to insects, etc., and thus securing dispersal. Malme found that in the material collected in June and July, long after the rains, the perithecia were empty. In May the disappearance of the spores was less marked. Keys are provided for both genera. A. L. S.

Classification of Lichens.—W. WATSON (*New Phytologist*, 1929, **28**, I., 1-36; II., 85-116). The author has gone over the whole field of lichens in his survey. He follows more or less the accepted lines of demarcation known to us in Zahlbruckner's treatment of lichen classes and families, but he proposes a somewhat different arrangement of the orders of Ascolichens. He arranges them thus: (1) Pyreno-carpales; (2) Conio-carpales; (3) Graphidales; (4) Collemales; (5) Peltigerales; (6) Ectolechiales; (7) Cladoniales; (8) Parmeliales. Watson constantly bears in mind the phylogeny of the groups, though he is influenced now and again by convenience of arrangement, and in several instances he has suggested as of generic importance certain sections of the larger genera. Thus, in *Parmelia* the sections or sub-genera *Hypogymnia*, *Menegazzia*, and *Omphalodium* he would rank as genera. Likewise in *Cladonia* he recognises four separate genera: *Cladonia*, *Cladina*, *Clathrina*, and *Pycnothelia*; while *Gomphillus* has been removed from Cladoniaceæ and has been placed in a family of its own—Gomphillaceæ. Arthopyreniaceæ is also broken up into three separate families. The gonidium, the algal symbiont, is given due weight, as also its relation to the general structure resulting in a homoiomerous or heteromerous thallus. Spore structure is duly considered in the determination of genera; less importance is given to pycnidia (spermogonia). A list of books or papers bearing on classification is appended. A. L. S.

Lichen Ecology.—MARIA CENGIA-SAMBO ("Ecologia dei Licheni I. Licheni corticoli," *Atti Soc. Ital. Sci. Nat.*, 1928, **67**, 264-83; 1929, **68**, 1-13). In these papers on ecology the writer has examined, as of first importance, the habitat of the corticolous lichens with a view to correlating her results with geographical distribution. She considers them under several aspects—physical character of the tree surface or bark—as smooth, rough, warted, and furrowed; the bark conditions which influence the distribution of lichens rather than the kind of tree. A list is given of many different trees examined. Even on the same tree, or on the same trunk, a variation of the bark induces the growth of different lichens, as certain species require a special kind of cortex. In temperate latitudes, such as in Italy, the development of lichens, as of other epiphytes, is associated with the prevailing grade of humidity; the greater the humidity the greater the number of epiphytic lichens and the greater the number of individuals. Proof of this is given by comparing the amount of growth on the same kind of tree under varying aspects and conditions. A contrast is also drawn with the humid conditions of the tropics, favourable only to epiphyllous species, and also with desert conditions, where arboreal lichens are rare and terricolous or saxicolous species with reduced thallus preponderate. Certain species, however, are always associated with one kind of tree, such as those on pines. Again, it was noted that lichens change with the altitude above sea-level. In the tropics crustaceous species with minute thallus growing on leaves are the most abundant; in temperate climes a varied growth is found;

while in sub-Arctic regions foliose and frondose species are the most noticeable. In these latter regions corticolous lichens give place to saxicolous and terricolous forms. Thus *Parmelia acetabulum*, which in temperate regions is always a corticolous form, in Terra del Fuego is saxicolous; *Parmelia saxatilis* in Italy is truly saxicolous, in the Island of St. Helena it is corticolous. A note is also given on the struggle for existence: first crustaceous species arrive, which may be gradually overgrown and displaced by larger frondose or foliose forms. An extensive list of papers is appended.

A. L. S.

Moraine Lichens.—C. F. E. ERICHSEN-HAMBURG ("Die Flechten des Moränengebiets von Ostschleswig mit Berücksichtigung der angrenzenden Gebiete," *Verh. Bot. Ver. Prov. Brandenb.*, 1928, 60, Heft. 2, 128-72, 10 pls., 2 sketch-maps). The moraine region examined lies in Schleswig down to the Holstein border and the North Sea Canal. The soil is of clay and chalk, carried by glaciers and marked by a rich cultivation. A line of clay, poor in chalk and with close-set mounds, forms the western border. Further west still lies a sandy region poor in clay and chalk, flat and with fewer mounds—a land of moors and heaths. In Mid-Holstein the underlying rock emerges as the Gipsberg; further west, as Heligoland. Erichsen gives notes as to lichens previously recorded from the district. He himself collected 407 species, and, including the northern Schleswig area, 450. He has contrasted these numbers with the collections from Brandenburg and from East and West Prussia. Nine species new to science were found by him. The climate is Atlantic—moderate temperature, heavy rainfall, with great moisture and high westerly winds. Trees are scarce, and the less vigorous lichens are absent. Those that are abundant are frequently distorted, due to wind action, with thickening of the cortex and with frequent proliferations and swellings. Owing to the continual moisture, there are a large number of typically Atlantic species, though not so many as occur in North-West Germany. Many species on erratic boulders, heaths, and moors can be distinguished as distinctly glacial. Finally Erichsen groups the lichens under three principal areas: A. Strand zone—boulders, rubble dunes, dune wood, and cliffs, etc.; B. Moraine districts—including woods, hedges, dwellings, walls, etc.; C. Sand territory—woods, heaths, moors, inland dunes, etc. A. The maritime coastal region, discussed under four zones in their relation to the sea. Of these, the supramarine upper zone is the richest in species, the lichens of the boulders being fairly similar to those in the inland dunes. B. The true moraine territory, which is highly cultivated, and where, therefore, lichen vegetation is somewhat scanty owing to intensive care of fields and woods. Many of the rare lichens that were found by Nolte have disappeared now or are in poor condition. Lists are given by Erichsen of those found on the various substrata, or on the different trees, and also on pollarded trees. Very few were found on soil. A further instalment of the paper is promised.

A. L. S.

Nostoc as Symbiont.—A. N. DANILOV ("Nostoc en état de symbiose," *Arch. Russ. Protist.*, 1927, 6, 83-92, 1 pl., Russian with French *résumé*. See *Bot. Centralbl.*, 1929, 156, 359). Danilov has made a study of the relationship between the alga *Nostoc* and the roots of *Encephalartos villosus* and also with lichens. A large series of algal forms have been united under *Nostoc punctiforme*, but study is necessary to differentiate the various types. The rounded form, common to so many of the algal cells, is, he considers, due to delayed development. In lichens the fungus gains nourishment from the gelatinous covering of the alga. The *Nostoc* forms chains of cells, though life continues also as cell units. The changed circumstances of both symbionts testifies to a labile condition of the alga.

A. L. S.

Lichen Gonidia.—E. BACHMANN ("Zur Gonidienvermehrung bei Flechten," *Ber. Deutsch. Bot. Ges.*, 1927, 45, 308-14, 2 text-figs.). Bachmann has given the results of his researches on the relation between the symbionts in the lichen thallus. He examined the thallus of *Lecidea expansa* in connection with the arrival of algal cells from the open. These are gradually surrounded by the thalline hyphæ and add to the thickness of the thallus. Another study concerned *Cladonia ochrochlora*, on the squamules of which he studied the effect of alighting soredia. These also were included and covered over by the cortex, indicated by a small elevation. There followed increased activity and a richer development of the lichen tissues. On *Diploschistes scruposus* he noted the arrival of algal cells, which, on alighting, had penetrated the cortex and protruded into the thallus: the tissues at these areas had become very dense. Both symbionts increase, but there is no evidence of any struggle between the two components or of any subjugation of the gonidia. At the base of the thallus there is a thick necral tissue layer composed of empty algal cells and dead hyphal remains, the contents of both having contributed to the enrichment of the still growing parts. Similar wart-like outgrowths were examined in *Lecanactis Stenhammari* with *Trentepohlia* gonidia. He sectioned one of the dark excrescences (about 63μ in height), which he found had a broken cortex and was occupied by a dense plectenchyma of hyphæ and gonidia, the latter retaining a radial direction of growth; the individual, somewhat elongated cells had become isolated and surrounded by hyphæ. The hyphal cells had also increased in length in a radial direction. Bachmann, however, considers that these warts probably do not affect the general thallus; they play the rôle of isidia in increasing the assimilating surface and contribute to the aeration of the lichen. In this lichen, also, Bachmann finds that all the evidence points to the mutual symbiotic growth of alga and fungus.

A. L. S.

Lichen Galls.—E. BACHMANN ("Tiergallen auf Flechten," *Archiv. Protistenk.*, 1929, 66, 61-103, 40 text-figs.). In this paper Bachmann follows up his work on galls caused by fungi. Zopf and Crombie had already noted these animal galls. Bachmann has selected two lichens for observation, *Ramalina fraxinea* and *Cladonia ochrochlora*. As to the creatures causing the galls, he found in those of *Ramalina* numerous scales of a moth, and, in addition, he discovered the larvæ and chrysalis of some butterfly; but satisfactory determinations were impossible. Bachmann quotes with approval Zopf's statement that the gall-producer exercises some exciting influence on the tissues, causing unnatural growth. There is no destruction of the lichen, as the gonidia are left unimpaired, thus contrasting with the fungus parasitic invasion, where the fungus attacks the gonidia and in time causes the death of the tissues. Bachmann has given a long, detailed description of the galls and of the altered tissues: in *Ramalina*, where they cause distortion and swellings of the fronds; in *Cladonia*, where they form abnormal growths on squamules and podetia. On *Cladonia* the galls are limited in extent; in *Ramalina* their influence is more widespread. Only minute remains and excrements were found in the *Cladonia* galls; it was impossible to determine the invader.

A. L. S.

Lichens as Food for Snails.—GÜNTHER SCHMID ("Endolitische Kalkflechten und Schneckenfrasz," *Biol. Zentrabl.*, 1929, 46, 28-35). The author selected for observation two minute snails, *Chronodrina avenacea* and *Pyramidula rupestris*: the first a few millimetres in length, but with a shell 2×7 mm. in size; the latter still smaller, with a shell 2.5×1.5 mm. Both inhabited limestone, living on the sun-warmed surfaces. Such a surface is described from the Bavarian Alps in the Isar valley—a smooth rock surface grey with crustaceous lichens, with

soil encroaching at the edges or in cracks, and there occupied by higher plants. Large expanses were solely occupied by the endolithic calcivorous lichens *Verrucaria calciseda* and *Protoblastenia rupestris*. The snails, in moist weather, were seen to creep over the surface, their gnawing movement very distinct. Their excrements were microscopically examined, and digested remains of the lichen hyphæ and spores were noted, as well as an abundance of undigested algæ along with lime crystals. Schmid correlates the consumption of the hyphæ with the known facts as to the large amount of fat contained in the hyphal cells of endolithic lichens, such as *Verrucaria calciseda*, which penetrates 10–12 mm. into the rock or even deeper, with a gonidial zone about 30–40 μ thick. With the exception of the cortical layer, the hyphæ are rich in oil, its production associated with the setting free of carbon dioxide. The fat content has been reckoned as about 90 p.c. of the dry substance of the thallus, and it is this special lichen that was the favourite food of the snails. No traces of the fat cells were found in the excrements; evidently they were completely digested. Experiments were made to test the ability of the snails to use other food, and some were kept without nourishment for a time and then given other substances found on the rocks—humus, *Trentepohlia*, *Nostoc*, and flowering plants. These were barely nibbled by the snails, but traces of them reappeared in the excrements. It is still a moot question whether *Trentepohlia* might have served as a food.

A. L. S.

Mycetozoa.

Study of *Didymium difforme*.—F. X. SKUPIENSKI ("Étude biocytologique du *Didymium difforme*, Première partie," *Acta Soc. Bot. Poloniae*, 1928, 5, n. 3, 255–336, 7 pls., 32 text-figs., Polish with French résumé). *Didymium difforme* is a common cosmopolitan mycetozoon; it grows on dead vegetation and is easily cultivated on artificial media. The cycle of development occupies about 14–16 days. The plasmodium of fine branched filaments is yellowish or greyish in colour; fructification is generally by sessile sporangia or sometimes by plasmodiocarps. The species is distinctly hydrotropic. It lives in association with a *Bacterium* allied to *Bacillus vulgaris*, the presence of which is essential, though germination is independent of the *Bacillus*. A series of experiments gave proof of its importance: other organisms introduced, *Aspergillus* sp., *Torula* sp., etc., added vigour to the plasmodium, but induced profound changes. In natural conditions it is a special *Bacterium* with which the *Mycetozoon* enters into symbiosis. The influence of temperature and light is considered—the latter accelerates fructification. Skupienksi, by a series of experiments with the zoospores, has demonstrated that they give rise to + and – zoospores and myxamœbæ. In culture tubes with cultures from several spores, both + and – fine plasmodia were formed in a few days, while in tubes with only one spore they failed to develop, though zoospores and myxamœbæ were formed in abundance. It is truly a heterothallic species requiring two types of myxamœbic gametes to form the plasmodium and subsequent fructification. An account is given in detail of division of zoospores and of nuclei. Finally he states that in this species the plasmodium may be formed by the fusion of only two myxamœbæ, but that also many such fusions may have taken part in the one *Mycetozoon*. The nuclei that do not finally unite degenerate. A list of literature is appended.

A. L. S.

Japanese Mycetozoa.—YOSHIKADZU EMOTO ("Ueber neue Myxomyceten," *Bot. Mag., Tokyo*, 1929, 43, 169–73, 1 pl., Japanese with German résumé). Emoto describes two new mycetozoa that he himself collected at Kanagawa. One is *Clastoderma Debaryanum* var. *imperatoria*, and was found on oak bark (*Quercus*

acuta); the other, *Diderma imperialis*, also grew on living bark of *Cryptomeria Japonica* and on the leaves of *Leucobryum* sp. A list of literature on mycetozoa is appended. A. L. S.

Michigan Mycetozoa.—ALFRED H. POVAH (*Mich. Acad. Sci. Arts and Letters*, 1928 (1929), 9, 255–6). The species enumerated were collected during a scientific survey of north-eastern Michigan. The dry season was specially unfavourable to this group of organisms, and most of the records are from the bogs which occur in that part of the state—spruce-cedar swamp, tamarack bog, and black-ash swamp. Sixteen species were found and determined. A. L. S.

NOTICES OF NEW BOOKS.

Catalogue of the Madreporarian Corals in the British Museum (Natural History).—Vol. VII. A Monograph of the Recent Meandroid *Astræidæ*.—By GEORGE MATTHAI, M.A. 1928. v, 288 pp., 72 plates, 35 text-figs. Published by the British Museum (Natural History), Cromwell Road, S.W. 7. Price £3 3s.

Zoologisch-mikroskopische Methodik mit Einschluss der embryologischen Technik.—By W. A. COLLIER. 1929. 463 pp. Published by Urban & Schwarzenberg, Friedrichstrasse 105B, Berlin N 24. Price 24 marks.

Practical Bacteriology.—By FRED W. TANNER, Ph.D. 1928. xiv, 235 pp., 67 text-figs. Published by John Wiley & Sons, Inc., New York, and Chapman & Hall, Ltd., 11, Henrietta Street, Covent Garden, London, W.C. 2. Price 12s. 6d.

This book has been prepared to accompany the author's larger work on bacteriology. It consists of details of technique, including a chapter on the microscope, details of the preparation of culture media, methods of microscopic technique, and of isolation of bacteria. The exercises are devoted to the study of soil and food organisms, yeasts, and moulds. The book is intended for those interested in or teaching general bacteriology as apart from medical bacteriology. J. E. M.

Laboratory Manual of General Microbiology.—By E. B. FRED, Ph.D., and S. A. WAKSMAN, Ph.D. 1928. viii, 145 pp., 18 text-figs. Published by McGraw-Hill Publishing Co., Ltd., 6 and 8, Bouverie Street, London, E.C.4. Price 10s.

This small book of 145 pages is intended primarily for those working with soil organisms. It contains no references to human or animal bacteriology. The first third of the text is devoted to the preparation of media, and 111 varieties are described. These are almost entirely for the cultivation of soil organisms. A few pages are devoted to the methods of staining bacteria, while the middle third of the book gives methods of qualitative and quantitative analysis. The remaining third deals with a series of 58 exercises in the study of micro-organisms of the soil. This small book is an excellent introduction to the study of agricultural bacteriology. J. E. M.

Bacteriology: a Text-Book of Micro-Organisms.—By FRED WILBUR TANNER. 1928. xvii, 548 pp., 1 plate, 138 text-figs. Published by John Wiley & Sons, Inc., New York, and Chapman & Hall, Ltd., 11, Henrietta Street, Covent Garden, London, W.C.2. Price 22s. 6d.

This book is a general treatise on microbiology, and deals with groups of bacteria as a whole without describing individual forms. A number of pages at the beginning are devoted to the history of the development of the microscope, followed by the early work in bacteriology and a short history of the pioneers, such as Koch, Pasteur, Metchnikoff, and Lister. The different forms of bacteria are described, their morphology, structure, and physiology being given in detail. Being an American book, the classification of the Society of American Bacteriologists is given full prominence. The book deals mainly with domestic and soil bacteriology, and only deals with medical bacteria when they illustrate some type of infection. Technique is not mentioned, but two chapters on general immunity are included. The book is useful for those doing bacteriology from the agricultural or domestic point of view.

J. E. M.

A Manual of Helminthology, Medical and Veterinary.—By H. A. BAYLIS. 1929. xi, 303 pp., 200 text-figs. Published by Baillière, Tindall & Cox, 7 and 8, Henrietta Street, Covent Garden, London. Price 30s.

The author has written with the primary object of providing concise descriptions of most of the genera and species of helminths living in man and the commoner domestic animals, so as to enable the reader to give at least approximate determinations of the more commonly encountered helminthic parasites. Such a book has long been needed, and the present volume is a welcome addition to helminthological literature. The subject is treated clearly and concisely from the above standpoint, and where species are very numerous the more important distinctive characters are given in tabular form. Many of the species are illustrated. Part I deals with the flatworms, and the sections on trematodes and cestodes open with a brief description of the general characters of the two classes. Part II, which is devoted to nematodes, occupies rather more than half the book and is similarly prefaced. At the conclusion is given a useful list of the parasites of man and the principal domestic animals arranged under their hosts. As a whole the book may be said to be better adapted to the needs of the student of zoology specialising in helminthology rather than to the medical man or veterinarian, as the title suggests, although the avoidance of any mention of the pathological and clinical aspects of the subject is intentional on the part of the author.

J. L.

Elektrizität und Eiweisse, insbesondere des Zellplasmas.—By Dr. HANS PFEIFFER. 1929. xii, 149 pp., 7 text-figs. Published by Theodore Steinkopff, Dresden and Leipzig.

This is an attempt to collect and correlate the results of investigations on electricity in connection with proteins in their bearing on cell activity. The first section deals with the origin of the electric charge of colloidal particles, and details shortly the various theories which have been advanced to account for it. The second part treats of the properties of iso-electric protein, of osmotic pressure, viscosity, swelling, and agglutination of proteins generally. In the third a review is given of the work which has been done towards establishing a connection between the behaviour of cells and the electrical reactions of simpler forms of protein. Although, inevitably, certain points are not completely treated in the text, the extensive bibliography and full author and subject indexes make it a useful work of reference.

J. C. B.

JOURNAL
OF THE
ROYAL MICROSCOPICAL SOCIETY.
DECEMBER, 1929.

TRANSACTIONS OF THE SOCIETY.

XXV.—NOTE ON THE NUTRIENT MEMBRANE OF
GRANTIA AMPHIBLASTULA.

By J. BRONTË GATENBY and S. D. KING, Zoological School,
Trinity College, Dublin.

(Read November 20, 1929.)

ONE PLATE.

IN well-fixed preparations of *Grantia compressa* the amphiblastula larvæ are found to be surrounded by a layer of flat cells filled with osmiophile granules. There can be no doubt that these membranes form a sort of placenta between the mother sponge and the larvæ the latter contains.

In a previous paper Gatenby (1920) gave a description of the development of *Grantia compressa*, and it is not necessary to enter into this fully. The segmenting eggs, which lie beneath the gastral cavities, give rise each to a blastula, one side of which becomes differentiated into the future flagellated layer (FC in fig. 1), and the remainder chiefly into larger paler cells, the posterior granular cells (GC in fig. 1). At about the stage drawn in fig. 1, numbers of wandering cells, AC', can be noted in the region of the amphiblastula. These would seem to fall under the category of amœbocytes. In a later stage these amœbocytes become more numerous, either by division or by the wandering in of others. Such a stage is shown in fig. 3, where about eight amœbocytes can be seen.

In a still later stage this broken chain of amœbocytes joins up to form a wall around the amphiblastula, as shown in figs. 2 and 4. Usually a

space (SS) is found between the wall and the embryo. This is possibly only a shrinkage cavity.

Followed through the sections of an amphiblastula, the sheath seems to be complete in many of the examples we have studied, but in others gaps, uncovered by cells, exist.

Examination of figs. 2 and 4 shows that the amphiblastula sheath is differentiated into two parts: one, on the left of fig. 2 and below in fig. 4, is more granular than the other. The non-granular part abuts against the flagellated layer of the amphiblastula, the granular against the posterior granular cells of the embryo. When the amphiblastula is making its way out of the sponge, the sheath must be the first part to be ruptured.

REFERENCE.

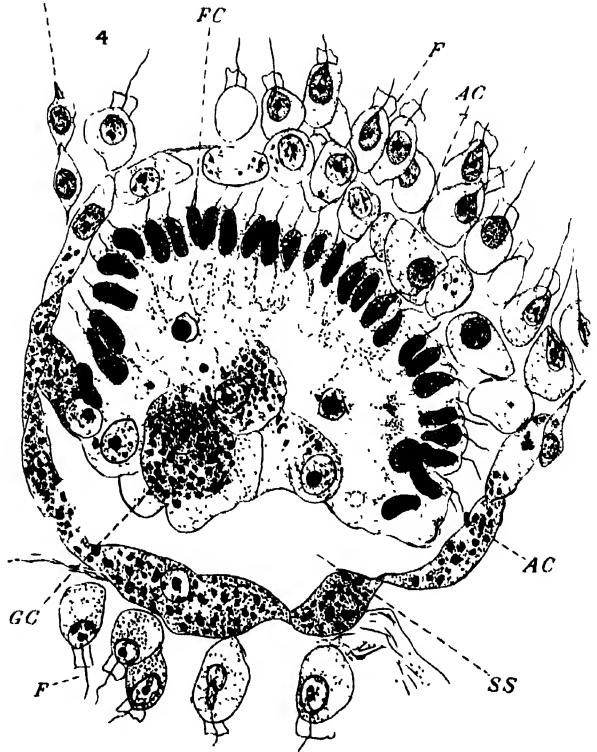
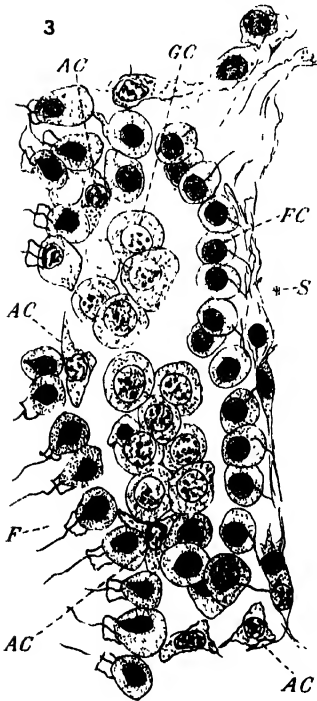
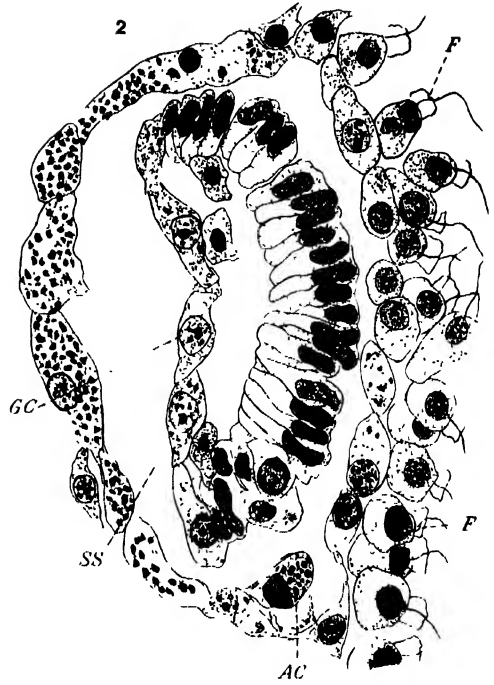
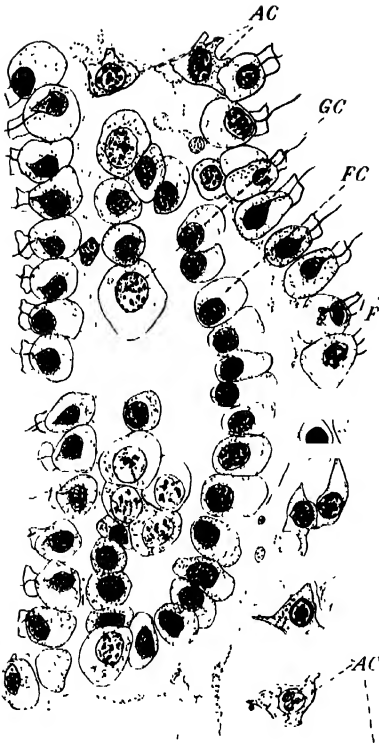
GATENBY, J. B. (1920).—J. Linnean Soc. (Zool.), **34**, 261-97.

DESCRIPTION OF PLATE.

LETTERING.

- AC = Amœbocyte.
- F = Flagellated chamber of sponge.
- FC = Flagellated cells of embryo.
- GC = Granular cells of embryo.
- S = Space in sponge.
- SS = Supposed shrinkage cavity.

Figs. 1-4, *Grantia compressa* amphiblastulæ at different stages, showing surrounding cells. Material fixed in Bouin's fluid and stained in alüm hæmatoxylin.



XXVI.—*DICRANOPHORUS HUDSONI* (GLASCOTT).

By P. DE BEAUCHAMP, D.Sc., Professor at the University of Strasburg.

(Communicated by DAVID BRYCE, F.R.S.E., F.R.M.S.)

(Read November 20, 1929.)

ONE PLATE.

IN the spring of this year Mr. Bryce sent me some living specimens of a curious rotifer which does not appear to have been seen* since its description by Miss Glascott (1898) under the name of *Diglena hudsoni*, and was consequently not figured by Haring and Myers (1928) in their masterly revision of the Forcipate Notommatidæ. My observations, although somewhat incomplete in consequence of the too rapid death of the animals, enable me to furnish here a more detailed diagnosis. My warm thanks are due to Mr. Bryce for the gift of the valuable material and for the translation of this note.

The species had been found by Miss Glascott among *Cladophora* in a "tide-pool," perhaps a little brackish at the time, of the River Barrow, in the south of Ireland. Mr. Bryce has met with it in the spring of 1928, 1928 and 1929, in the little brook running through Salfords (Horley, Surrey), and there in large floating flakes of mud arrested by a tree fallen in the stream. These mud-flakes, penetrated and held together by Oscillatoriaceæ and by Diatomaceæ, have apparently been detached from the bottom and brought to the surface by the disengagement of gases from the algæ under the rays of the sun. Their fauna (*Hydatina* and numerous *Infusoria*), like their flora, are just those of mud surfaces rich in organic matter. In passing, I may mention that I have found also in the material some examples of *Encentrum saundersiæ* (Hudson) agreeing well with the description given by Haring and Myers (*loc. cit.*, p. 778), except that they were quite free of the intestinal *Zoochlorellæ* usual in this species, a freedom which accentuated their resemblance to *E. phicatum* (Eyferth), sufficiently distinguishable by its mastax.

Dicranophorus hudsoni, as has been well remarked by Miss Glascott, if in a contracted or half extended position, might easily be taken for a Bdelloid from its form, the aspect of its integument, and its distinctive movements. When fully extended (the length then attains 350–400 μ), the appearance is that of a flagon with a swollen ovoid body, separated by a slight constriction from a gradually tapering neck, which is wholly retractile.

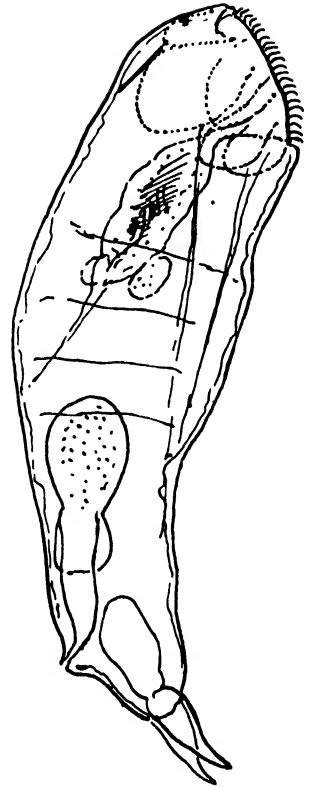
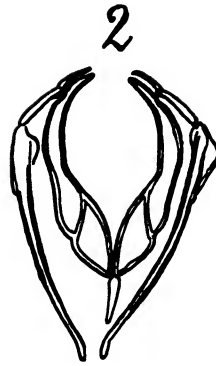
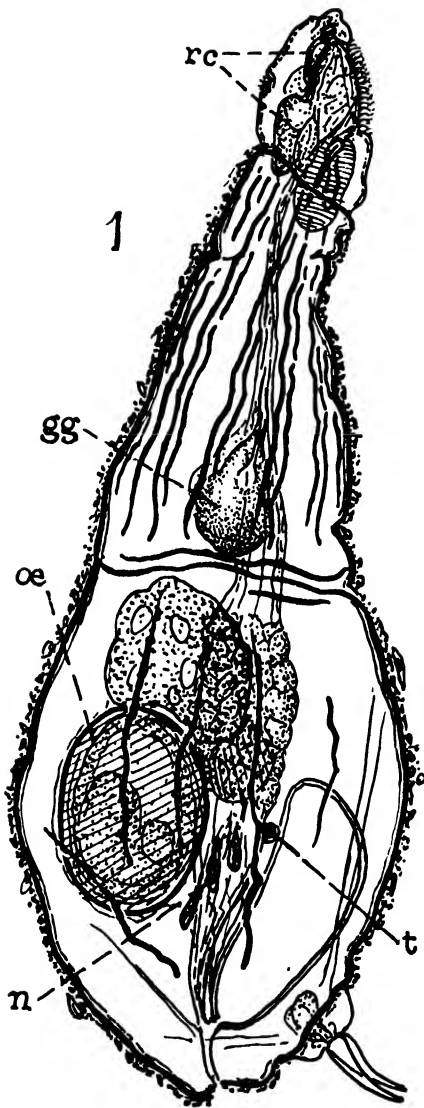
* Mr. Bryce has pointed out that *Diglena hudsoni* Glascott is mentioned by Roussetlet (1906) in his list of the Rotifers of Cape Colony, on the authority of Milne.

The anus is nearly terminal, and more ventrally is placed a very short foot of a single joint, with two small, tapering, decurved toes. These appear to be mobile only in the median plane and little or non-retractile; their glands are much reduced. The whole surface shows longitudinal folds, few on the abdomen (where, towards the middle of each flank, one can perceive the furrows of the lateral antennæ), more numerous on the neck, which has at least a dozen. The integument itself is tough and viscid, always covered with small portions of mud, diatoms, etc., which have stuck to it and impeded very much the study of the internal organs (in the figure this coating is indicated only on the margins).

On the other hand, when the head is pushed forward beyond the anterior limit of the neck, it is seen to have a clean and transparent skin. The head is truncated obliquely in front by the corona (or ciliated organ), reduced here to a single circular, buccal area, uniformly clothed with fine cilia, and surrounded by a prominent border. To me the upper portion does not appear to form a hook-like hood, analogous to that of some related species, as figured by Miss Glascott. Near the lower border is the mouth; close by the upper open the two ducts of the retro-cerebral apparatus (made visible by vital staining); the sac itself is but little developed and does not appear to be hollow; two small cellules, which flank it (I can only say) may be sub-cerebral glands. The dorsal antenna is in a small furrow about central on the head.

In the extended position the mastax is level with the mouth, as customary in the genus and contrary to Miss Glascott's statement. It is a very simple forcipate mastax, with a single tooth to each uncus and ramus alike, and a very small process of the former serves to articulate it to the latter. It somewhat resembles, with some differences in proportions, the mastax of *Dicranophorus permollis* (Gosse), a species otherwise very different (Harring and Myers, *loc. cit.*, pl. xxxiv, figs 1, 2). There follows next a long œsophagus with delicate walls and occupying all the cervical region; the gastric glands are inserted on it towards its lower third, as in *Asplanchna*; they are large, flattened and nearly triangular, with a very distinct duct. The stomach and the intestine present no special features, any more than does the spacious bladder to their ventral side. Of the nephridial system I have observed only three flame-cells, grouped on the side of the intestine, but, considering the impaired transparency of the animal, it may well be that there are others.

The generative system shows another peculiarity exceptional among the Notommatidæ, but known already in a single species (described by Harring and Myers) of the genus *Lindia*, viz., its viviparity. Moreover, the ovary and the two or three embryos contained in the oviduct (the older of them showing movements) are placed laterally to the alimentary canal, frequently, indeed, pushing over into the dorsal region of the abdomen. The longest surviving females of Mr. Bryce's material were mictic and fertilised, and it is one of these which is represented in my figure. In her body was enclosed



a resting egg (of these there may be as many as three), of regularly oval form, having a shell of yellowish colour, but without ornamentation and transparent, which permitted one to distinguish the embryo forming a kind of blastula, as is usual before entering upon passive life. The resting eggs seemed to be retained in the body, and only to be set free by the disintegration of the animal.

As to the male, which is to be understood as being brought forth alive in the same way as the females which issue from the parthenogenetic eggs, I have had only a glimpse of it. As the figure shows, it resembles the adult female very little (much more closely, however, the young female when just born), the cephalic extremity being proportionally less narrow and the integument soft and clean; it seems also to have stouter and less curved toes, with more developed glands. A granular tract represents the digestive tube.

The ethology of the animal is evidently very special, and may explain its rarity, the surroundings where it has been found having only a commonplace character; but my observations are very fragmentary. I have never seen it swim, nor even creep by the aid of the cilia, although Miss Glascott, who has very well described its behaviour, has seen the latter action. It travels always by creeping in the fashion of a Bdelloid, the adherence of the anterior portion of the neck being more or less due to the viscid nature of the skin. Most frequently it remains at one spot outstretched along a fibre of *Oscillatoria*, alternately and slowly retracting and extending its head. Although the mastax suggests a predatory habit, I have never seen it attempt to seize anything, even a diatom; the digestive tube contains only some shapeless remains, and the walls of the stomach enclose fine yellowish granules.

As regards its systematic position, under the classification of Harring and Myers it certainly comes into the genus *Dicranophorus*, the old genus *Diglena* amended; the mobility of the uncus upon the ramus forbids its inclusion in *Encentrum*. A special genus for it would not be out of place in view of its individuality, looking especially at the position of the gastric glands and the viviparity; yet there is no urgency for its creation before the moment when it becomes needful to subdivide the genus *Dicranophorus*, which is still somewhat heterogeneous.

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DESCRIPTION OF PLATE.

- Fig. 1.—*Dicranophorus hudsoni* (Glascott), mictic ♀, containing a resting egg, × circa 350.
gg. gastric glands; n. flame cells; α. egg; rc. retro-cerebral organ; t. lateral antenna.
Fig. 2.—Mastax of *Dicranophorus hudsoni* ♀. × 1000.
Fig. 3.—*Dicranophorus hudsoni* ♂, × circa 400.

XXVII.—SOME NEW FORAMINIFERA FROM THE SOUTH ATLANTIC.

II.

By E. HERON-ALLEN, F.R.S., F.R.M.S., and ARTHUR EARLAND, F.R.M.S.

(Read December 18, 1929.)

FOUR PLATES.

Order—Foraminifera.

Family—Astrorhizidæ.

Sub-Family—Astrorhizinæ.

Genus—Diffusilina. Heron-Allen & Earland, 1924.

DIFFUSILINA PAPILLATA sp. nov.

Plate I, figs. 4–6.

TEST attached to stones and other objects, generally roughly circular in outline, though the edges are frequently produced into irregular cusps. In form, more or less convex, built up of finely comminuted sand and mud, firmly compacted but without much cement, except in the outer layer, which is very smooth, even polished, but with one or more well-marked projecting papillæ formed of the same minute sand grains more loosely agglutinated. These papillæ presumably form the avenues for the extrusion of the protoplasm, which, however, may perhaps also find an exit round the edges of the test, although these appear to be in close contact with the surface of attachment. Colour varying from dirty white to grey.

Specimens broken open reveal a simple cavity with lobular extensions—in fact, amœboid in shape—filled with pale brown protoplasm. Larger sand grains are used in the construction of the interior than in the outer layer of the wall. No passages connecting the central cavity with the papillæ or the edges can be made out. Probably the protoplasm exudes in a fluid form between the sand grains, and digestion is carried on outside the test.

The size varies up to about 2 mm. in diameter. It is not uncommon on stones at Station W.S. 242, depth 119 metres, and may be widely distributed in the Falkland area, and perhaps elsewhere, if searched for in suitable material. A specimen of *Protobotellina cylindrica* H.A. & E., from Station W.S. 243, was almost covered with small individuals.



The specimens are tentatively assigned to the genus *Diffusilina*, which was instituted by Heron-Allen & Earland (1924*) for the reception of organisms sessile on calcareous algæ from Lord Howe Island, South Pacific. The genotype *D. humilis* is irregular in shape, conforming to the depressions and crevices in which it lives. In general external appearance, especially in the surface papillæ, the Falkland species bears great resemblance to *D. humilis*, but is evidently of a more primitive type, as evidenced by its simple lobulate chamber compared with the ramifying unseptate tubes of the genotype.

For this reason it may be necessary to reconsider the taxonomical position of the genus. In 1924 we stated that "the affinities of *Diffusilina* are not easily discoverable . . . it has no close relationship to any previously recorded type. We suggest *Bdelloidina* as its nearest, but still a distant, ally." The presence of the lobulate amœboid chamber in *D. papillata* leads us to the opinion that the genus should be transferred to the *Astrorhizidæ*, in proximity to our genus *Iridia*.

Sub-Family—Saccammininæ.

Genus—*Psammosphæra*. Schulze, 1875.

? *PSAMMOSPHERA FUSCA* Schulze.

Plate I, figs. 1-3.

The specimens figured were drawn for purposes of record pending investigation of their internal structure. They are now believed to be sessile specimens of *Psammosphæra fusca* Schulze, a species which is both abundant and variable in the Falkland area. The bizarre forms shown in the illustrations are apparently due to the incorporation of large sand grains which have subsequently broken away from the specimens. Similar specimens of *Psammosphæra* with one or more large inclusions still in position have been noticed at several stations.

Sub-Family—Saccammininæ.

Genus—*Tholosina*. Rhumbler, 1895.

THOLOSINA VESICULARIS (H. B. Brady) var. nov. *ERECTA*.

Plate I, figs. 7-8.

Placopsilina vesicularis, Brady 1879. Quart. Journ. Mic. Sci., vol. xix, N.S., p. 51, pl. v, fig. 2. *Ibid.* 1884. Chall. Repts., vol. ix, p. 316, pl. xxxv, figs. 18, 19.

The characters of the variety are the same as those given by Brady for the species (*ut supra*), but the tubular extensions, instead of being attached

to the surface of the stone, are free and project above the organism like factory chimneys. Occasionally the tubes fork, a feature which Brady mentions in connection with the type, but which is, in our experience, very rarely seen.

The variety favours depressions and cavities in stones, and is accordingly less convex than the type. In many specimens it forms merely a flat arenaceous membrane enclosing a cavity and surrounded by vertical tubes as shown in fig. 8. The size is variable, but specimens have been seen up to 4 mm. in diameter.

Tholosina vesicularis is abundant and widely distributed in the Falkland area, but the variety *erecta* has so far only been observed at Station W.S. 242, 119 metres, where the presence of many decomposing rock fragments favoured its growth. Probably it occurs in many other suitable localities, as fragments of similar tubes have been observed at many stations which, until the discovery of the entire organism, were regarded as fragments of *Psammatotendron* Norman.

Sub-Family—Rhabdammininæ.

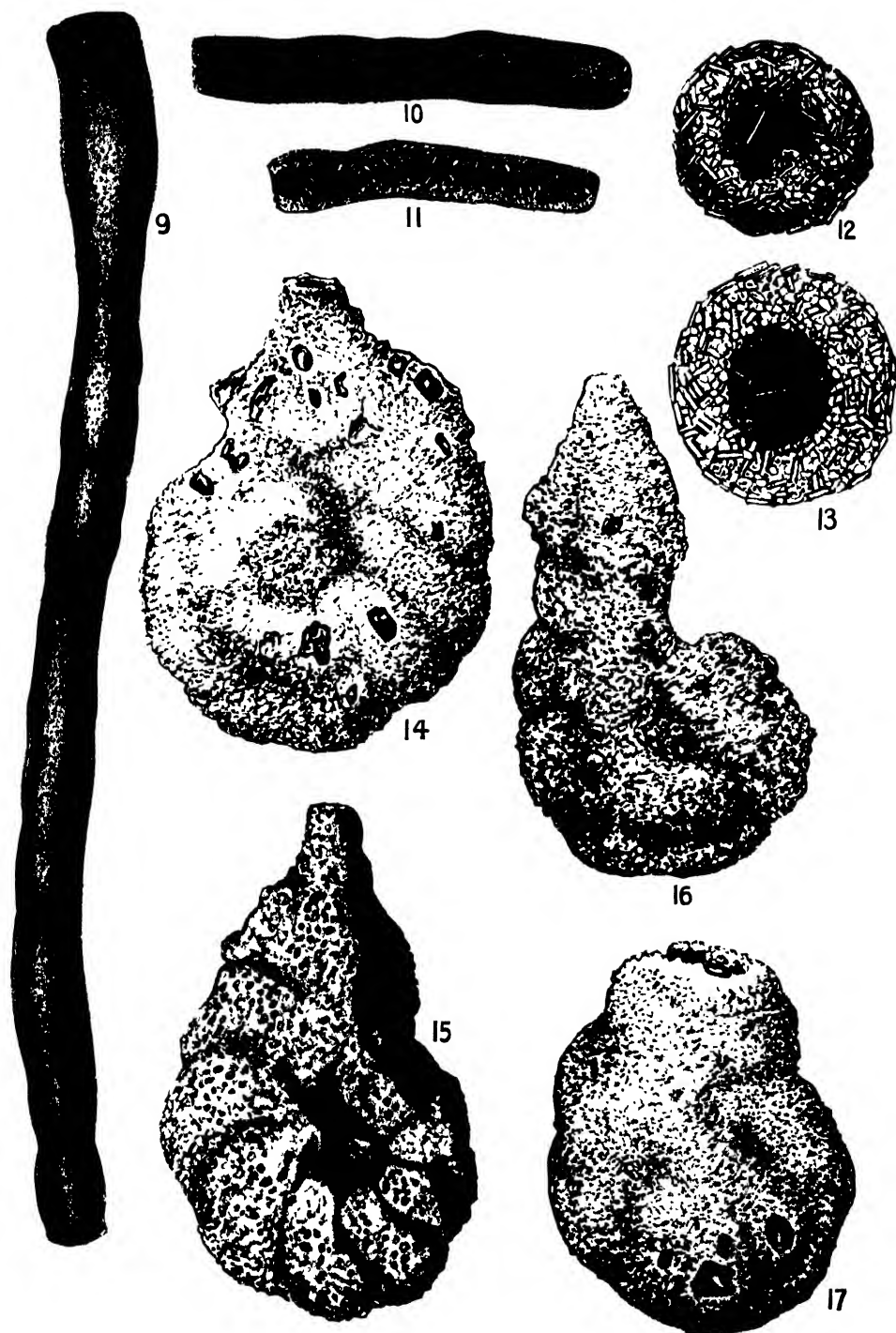
Genus—Protobotellina gen. nov.

PROTOBOTELLINA CYLINDRICA sp. nov.

Plate II, figs. 9–13.

Test large, irregularly cylindrical, in the form of an unseptate tube with walls of even thickness, open at one extremity, closed at the other. Colour dark grey to pale brown. The aboral extremity is abruptly truncated and exhibits no sign of a bulbous proloculum either externally or in section. The oral extremity is generally rounded off, but sometimes rather flattened and outspreading, and is furnished with a round or oval constricted aperture, which is reduced in size or defended by spicules, or larger sand grains projecting from the inner wall.

The wall is thick and built of fine sand grains and broken sponge spicules firmly agglutinated, but with little visible cement. The proportions of sand and spicules vary greatly; in some specimens the spicules predominate. The external surface is smooth and neatly finished. Feeble constrictions and swellings visible externally give an impression of internal septa which do not in fact exist. The central tube is unseptate and approximately of the same diameter throughout. Sections occasionally show a constriction of the inner tube due to a thickening of the wall, but these cannot be regarded as primitive or degenerate septa, nor do they coincide with the constrictions of the outer wall. In diameter the tube is about equal to the thickness of its surrounding wall.



The inner surface of the tube is extremely rough, owing to the projection of spicules and sand grains larger than those employed in the construction of the outer wall. These spicules and sand grains frequently project almost to the middle of the tube, but never across it, nor do they form a labyrinthic structure in the tube, as in *Botellina*. The entire tube is filled with a homogeneous mass of protoplasm, nearly black in colour.

The spicules and sand grains projecting from the inner wall are presumably to exclude parasitic worms. These are a source of trouble to most large foraminifera, and many devices are employed for their exclusion. That it is not entirely effective is proved by our finding a Sipunculid inside a large specimen. Whether such organisms resort to the tubes for food or shelter only we cannot say. They are not tube builders.

Externally *Protobotellina* bears considerable superficial resemblance to *Botellina labyrinthica* Brady, but a close examination reveals generic differences. The fine sand and spicules, although firmly built into the wall of *Protobotellina*, can be scraped away with a scalpel, and sections can be ground with little trouble. In *Botellina* the grains are larger and so firmly cemented together as to resist dislodgment without fracture, and sections are very hard to grind. Moreover, *Botellina*, on the rare occasions when it has been found perfect, exhibits a bulbous proloculum in strong contrast with *Protobotellina*, in which there is no increase in the diameter of the tube at the initial extremity. Sections of the two organisms exhibit a strong contrast between the projecting spicules of *Protobotellina* and the firmly built outgrowths which fill the tube of *Botellina* with a labyrinthine core.

The affinities of *Protobotellina* are not very evident. While placing it at present near *Botellina* on account of general resemblances and its primitive labyrinthic interior, we are not convinced that it lies in any direct relationship to that genus. The friable nature of the shell wall would suggest a connection with *Hyperammmina* but for the absence of a bulbous proloculum, which is even more characteristic of that genus than of *Botellina*.

Protobotellina cylindrica is widely distributed over the sandy area between the Falkland Islands and the coast of South America, but is probably never very abundant. We have perfect specimens from a number of stations, depths ranging between 150 and 300 metres, and fragments from others. The size varies greatly at different stations, but on the whole averages about 25 mm. in length and 4 mm. in diameter. A specimen from Station W.S. 248 was over $2\frac{1}{2}$ inches long, and fragments have been seen which suggest even larger dimensions.

The finding of living specimens with other foraminifera and polyzoa attached to the basal end indicates that the organism lies flat on the surface of the sandy bottom, and does not assume an erect position or attach itself basally to other objects.

Family—Lituolidæ.

Sub-Family—Lituolinæ.

Genus—Ammobaculites. Cushman, 1910.

AMMOBACULITES ROSTRATUS sp. nov.

Plate II, figs. 14–17.

Test free, thin-walled and rather fragile, compressed, plano-spiral and evolute. Consisting of 2-3 convolutions, with from 5-7 chambers in the last convolution. The final chamber is produced at a tangent to the spiral and terminates in a flattened nipple with slit-shaped aperture. Umbilical region depressed on both sides, marking the area of the inner convolutions. The chambers of the last convolution are slightly inflated and do not extend to the edge of the test, which is thus furnished with a solid carina having a rounded peripheral edge. The sutural lines are generally obscure. Colour light grey, rough and unpolished. Walls constructed either of fine sand and mud with a considerable proportion of grey cement, or of mud without apparent cement, according to the environment. When sand grains are employed they are generally minute and of uniform size, but whether sand or mud is used, symmetrical construction is often spoiled by the inclusion of one or two large grains. The nipple-like terminal of the final chamber is more neatly constructed than the rest of the shell.

The characteristic terminal chamber presumably marks the completion of growth, as it is only found in the largest specimens. For this reason, coupled with the fragility of the test, specimens exhibiting this feature are rare. Broken and immature specimens are of frequent occurrence, and in this condition it closely resembles *Ammobaculites americanus* Cushman (= *Haplophragmium fontinense* Brady non Terquem), to which our species is probably closely allied.

Dimensions.—Length of perfect specimens, 2.0 mm.–2.4 mm.; breadth, 1.4 mm.–1.6 mm.

Ammobaculites rostratus is not uncommon in the South Georgia area. The best specimens of the sandy form were found at "Discovery" Station 45, at a depth of 238–270 metres. The muddy form is equally fine in Cumberland Bay, South Georgia, 230–247 metres (Station M.S. 68).

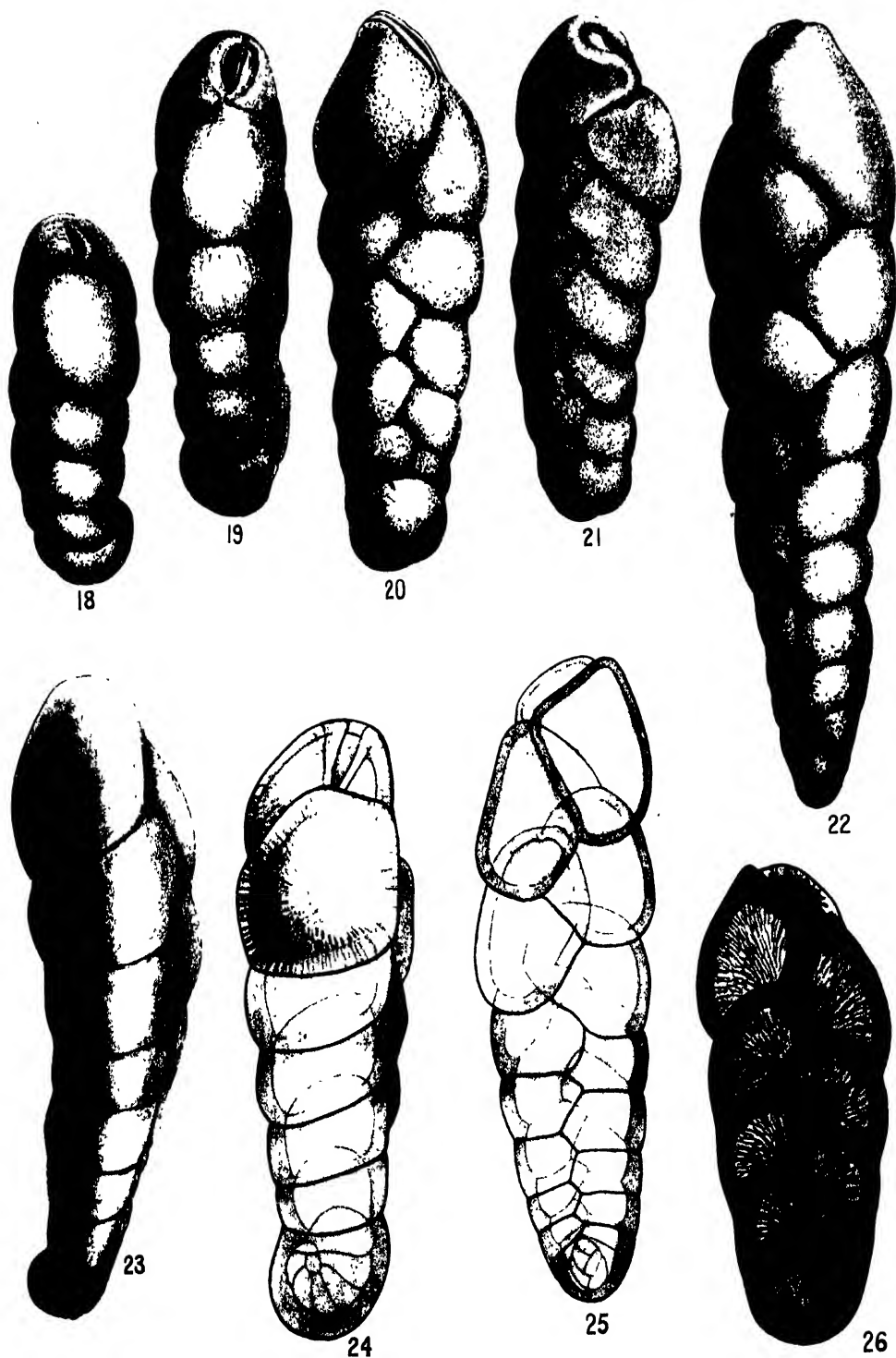
Sub-Family—Trochammininæ.

Genus—Trochammina. Parker & Jones, 1860.

TROCHAMMINA MALOSENSIS sp. nov.

Plate IV, figs. 27–32.

Test free, minute, arenaceous, consisting of numerous chambers arranged in a trochoid spiral of four or five coils. About five chambers in each



convolution, neatly constructed of fine sand and sponge spicules with more or less ferruginous cement, the colour of the whole test varying accordingly from white to brown. Sutures flush in early stages, but rather deeply depressed in last convolution, owing to the rapid inflation of the chambers, which results in a lobulate periphery to the shell. All chambers visible on the superior face, only those of the last convolution on the inferior side, which is deeply excavated in the centre. Aperture a looplike slit on inner edge of final chamber.

Dimensions.—Diameter, 0.16–0.25 mm.; height, 0.12 mm.

This pretty little species belongs to the *inflata* group. Its nearest allies are probably *T. rotaliformis* J. Wright, a common British species, from which it differs in the greater height of the spire and in the number of chambers, and *T. pacifica* Cushman, a very similar but much larger and more coarsely constructed form from British Columbia. It is one of the most characteristic of the Falkland Islands foraminifera, occurring with more or less frequency at eight stations, the best specimens being found at D. 48 (105 metres) and W.S. 88 (118 metres). It is named after the Falkland Islands, the “Iles Malouines” of d’Orbigny’s “Voyage dans l’Amerique Meridionale.” It occurs also, but more sparingly, in the S. Georgia area.

Family—Textulariidae.

Sub-Family—Cassidulininae.

Genus—Ehrenbergina. Reuss, 1850.

EHRENBURGINA CRASSA sp. nov.

Plate III, figs. 18–26.

Test very thick-walled throughout, finely perforate, hyaline in the younger stages, but frequently becoming white and semi-opaque in the adult shell. Constructed of a variable number of chambers regularly increasing in size, arranged biserially about an elongate axis and presenting well-marked dorsal and ventral sides. The main axis of the shell is normally straight, but occasionally exhibits a spiral tendency, thus giving a virguline appearance to such tests. The dorsal side of the test is flatter and wider than the ventral, and the sutural lines, which are depressed, are more prominent on the dorsal side owing to their greater thickness.

The sutures are most noticeable in the oral half of the shell, those of the initial half being usually more or less obscured by a secondary layer of shell substance which is sometimes granular or even feebly striated. The oral half of the shell is quite smooth and devoid of ornament. The aperture is a looplike slit set obliquely on the inner face of the final chamber.

The initial portion of the shell consists of a more or less prominent knob, curved over towards the ventral side and excentric to the main axis of the

shell. In the megalospheric form this knob is very prominent, and contains the proloculum situated on its ventral face, behind which is the first pair of chambers. In the microspheric form it contains the proloculum followed by one plano-spiral convolution of minute biserial chambers regularly increasing in size, the axis of the spiral being at right-angles to the main axis of the shell.

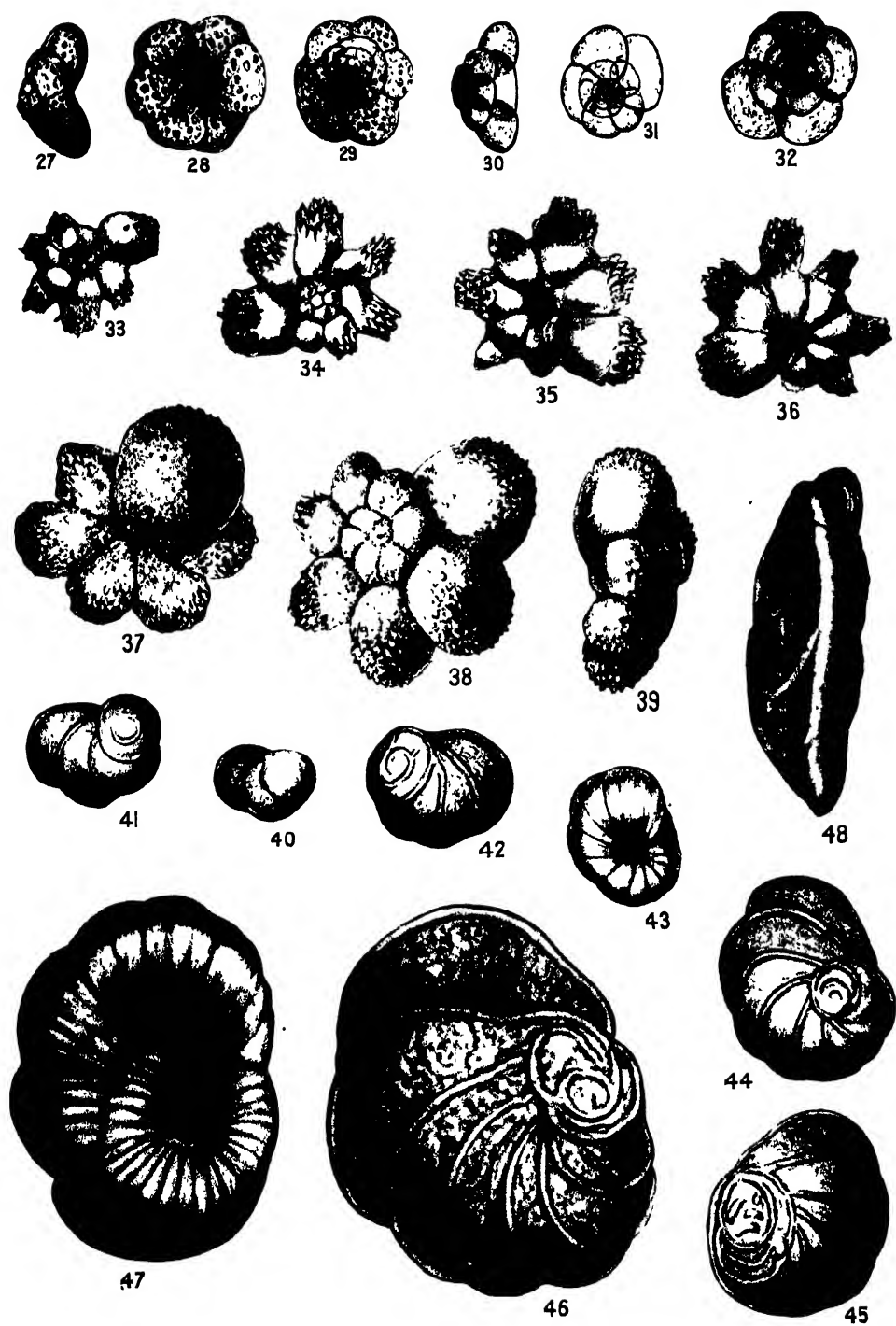
The megalospheric form predominates everywhere, sometimes to the entire exclusion of the microspheric. Its appearance is very distinctive, especially in young specimens, where the proloculum shows like a glassy bubble on the ventral side of the bulbous top. As the shell develops, it becomes less noticeable owing to the deposition of secondary shell matter. The pair of chambers immediately following the proloculum are compressed in shape, owing to their position on the dorsal side behind the proloculum. After them the chambers are regularly arranged biserially. Average specimens exhibit 4-5 pairs of chambers, but several specimens ranging up to 7-8 pairs have been seen.

The microspheric form is easily distinguished by its narrower initial end, which is rather wedge-shaped than bulbous. Owing to the thickness of the wall, it is difficult to make out the internal structure, but, so far as can be ascertained, the microspheric proloculum, which is very small, is followed by a plano-spiral coil of minute biserial chambers, probably 4-5 pairs, regularly increasing in size, after which the straight series is developed to the extent of a further 6-8 pairs of chambers. It thus attains a greater average length than the megalospheric, while preserving other dimensions much the same.

An average megalospheric specimen measures about 0.70 mm. in length by 0.30 mm. in greatest breadth and 0.25 mm. in thickness. One very large specimen attained 1.08 mm. in length. The megalosphere as measured in optical section (internal) averages 0.1 mm. in diameter.

Microspheric specimens average about 0.90 mm. long by 0.35 mm. in greatest width and 0.30 mm. in thickness. A large specimen attained 1.35 mm. in length. The microsphere could not be measured with any certainty owing to the thickness of the shell. It is certainly very minute.

Ehrenbergina crassa is a very abnormal type, and until the discovery of the microspheric form with its coiled initial portion definitely established its relationships, its position remained uncertain. Its nearest ally is unquestionably *Ehrenbergina pupa* (d'Orbigny), from which it differs in many points, notably in the marked development of the produced series of chambers and their regular Bolivine arrangement. *Ehrenbergina (Cassidulina) pupa* was first described by d'Orbigny from the Falkland Islands, and it is one of the most abundant and variable species in the "Discovery" collections from that area. None of the variations, however, approach *Ehrenbergina crassa*, which does not occur at all in the Falkland area, but is relatively common in South Georgia and adjacent waters, and, so far as our present knowledge goes, is strictly confined to that area, where it constitutes one of the most characteristic local species. These two areas are separated by deep water.



Presumably the two species, *E. pupa* and *E. crassa*, are derivatives from a common ancestor which inhabited both areas.

Ehrenbergina crassa has already been noted at nearly twenty stations in the South Georgia area in depths ranging between 18 and 846 metres, and is fairly plentiful at some of them. Microspheric specimens were found at six of these stations only, and were usually confined to a few specimens.

Family—Globigerinidæ.

Genus—Globigerina. d'Orbigny, 1826.

GLOBIGERINA CRISTATA sp. nov.

Plate IV, figs. 33-39.

Test minute, hyaline; a flattened trochoid spiral of from two to two and a half convolutions, with six or occasionally seven chambers, rapidly and regularly increasing in size, in each convolution. Dorsal surface almost flat, exhibiting all chambers. Ventral surface rounded and with the chambers of the last convolution only visible, the final chamber inflated and extending inwards over the umbilical cavity. Chambers inflated on the periphery and ventral side, flattened on the dorsal side. Sutures depressed and periphery deeply lobate in young specimens, markedly less lobate in the adult. Aperture an arch in the ventral umbilicus concealed by the extension of the final chamber.

In the early stages the walls are very thin and glassy, except on the peripheral edge, where each chamber is furnished with a solid knob or crest of shell substance covered with truncated spines. A few similar spines are distributed over the surface of the chambers near the peripheral edge. These solid extensions or crests form a very striking feature in the youngest specimens, in which they frequently equal and often exceed in bulk the chamber on which they are formed. As the shell increases in size, the crests diminish, the shell substance being apparently resorbed and redistributed over the walls of the chambers, which become thickened all over. At this stage, which appears to mark the completion of growth, the peripheral edge is regularly lobulate, and the entire surface of the chambers is covered with short blunt spines. Further development is now limited to the shell wall, which continues to increase in thickness until finally we attain a form which is almost uniformly thick-shelled, having a rough but not spinous surface, and with peripheral lobulations and sutural depressions reduced to a minimum.

Immature crested specimens range between 0.08 mm. and 0.11 mm. in greatest diameter, a considerable proportion of this size being due to the solid crests, which may be as much as 0.026 mm. in length compared with 0.022 mm., the breadth of the chamber to which the crest was attached. Fully-grown individuals range between 0.12 mm. and 0.18 mm. in diameter, and have a shell wall up to 0.026 mm. in thickness.

The species, which appears to be very distinctive, is frequent in a dredging made by the "Discovery" on 24 July, 1927, off Possession Island, S.W. Africa, in lat. $26^{\circ} 17' 40''$ S., long. $14^{\circ} 36' 20''$ W. Depth, 3170 metres.

The bottom was a very clean Globigerina ooze containing all the species normally found in an Atlantic ooze in such latitude, and many other forms of rarer occurrence, all in a remarkable state of preservation. A search through *Challenger* and other Atlantic material for this species—which, owing to the minute size of the crested forms, might easily have been overlooked—has not so far resulted in its discovery at other similar localities.

Family—Rotaliidae.

Sub-Family—Rotalinæ.

Genus—Discorbis. Lamarek, 1804.

DISCORBIS KEMPPI sp. nov.

Plate IV, figs. 40–48.

Test free, perforate, white in colour, consisting of flattened chambers arranged in a rapidly expanding coil of at most $1\frac{1}{2}$ convolutions. On the dorsal side, which is rather convex, the marginal edges of the chambers are strongly limbate, and the whole surface between these limbations is decorated with exogenous beads and zig-zag ornament which conceal the arrangement of the earliest chambers. There appear to be about eight chambers in the final convolution, perhaps twelve or thirteen in all. The peripheral edge is rounded and lobulate. On the ventral side, which is concave, the sutural lines are increasingly depressed with the growth of the shell, and the otherwise smooth surface is furrowed with lines converging on the oral aperture, which is situated in a depression and is a strongly arched opening (sometimes furnished with a tooth) at the centre of the inner marginal edge of the final chamber. There is a considerable amount of variation at different stations in the development of the external ornament and in the relations of length to breadth, but not sufficient, in our opinion, to justify even varietal separation.

One specimen found at Station W.S. 87, where the species occurs most frequently, has the dorsal side smooth, the sutural lines being limbate but almost flush. The arrangement of the chambers, which is usually obscured by the surface ornament, is easily made out in this specimen.

A complete series in all stages of growth was obtained at Station W.S. 87. There is no marked difference except in the strength of the ornament, which increases with age.

The dimensions vary between 0.24 mm. length, 0.2 mm. breadth in the smallest specimen found, and 1.4 mm. length, 1.05 mm. breadth in the largest, which is about 0.85 mm. in thickness.

We have pleasure in associating this species, which is perhaps the most

striking of the new species of foraminifera from the Falkland Islands, with the name of Dr. Stanley Kemp, the Director of the "Discovery" investigations.

Discorbis kempii occupies rather an isolated position, and a study of further material may necessitate the creation of a new genus. It has little in common with other species of *Discorbis*, and the only species with which we are acquainted having any close affinity is *Discorbis pulvinulinoides* Cushman (Bull. 71, U.S. Nat. Mus., 1915, p. 23, pl. vi, fig. 3), which was described by the author from "off Japan, 59 fms." Cushman's species resembles *D. kempii* in the structure of the ventral side, but differs in size, number of chambers, and markings. We have recorded some specimens from New Zealand and the Antarctic, with reservations, under the name *D. pulvinoides* * (Terra Nova Expedition, 1910, Zool., vol. vi, no. 2, p. 206). They may be specifically distinct from *D. pulvinulinoides* and *D. kempii*, as probably are some allied organisms in our collection from other localities (Torres Straits, Stewart Island, New Zealand). On the other hand, the Miocene specimens described by us from the Moorabool River, Victoria, Australia (J. Roy. Micr. Soc., 1924, p. 172), under the name *Discorbina pulvinoides* * Cushman, appear to be identical with that author's recent specimens from Japan.

The distribution of *Discorbis kempii* is very interesting. It occurs at "Discovery" Station 48, depth 105 metres, and "William Scoresby" Stations 84, 86, 87, 88, 89, 91, 92, 93, 248, at depths ranging between 23 and 191 metres. The best series of specimens are from Stations 86, 87, 88, where it attains splendid dimensions. At most other stations the specimens are small, poorly developed, and very rare. All these stations are situated within an area bounded by the Burdwood Bank, the Falkland Islands, and a line between the Falklands and Magellan Straits. It has not, so far, been discovered outside this area, and in view of the Pacific habitat of its only known allies, we can hardly doubt that it is a form of Pacific ancestry which has succeeded in weathering the Horn and establishing itself in the Atlantic Ocean, without as yet obtaining any wide distribution there.

The types of all species described in this paper are in the Heron-Allen and Earland collection at the British Museum (Natural History); paratypes are in the Cabinet of the Royal Microscopical Society.

PLATE I.

- Figs. 1-3.—*Psammosphæra fusca* Schulze, sessile form. × 20.
 Fig. 4.—*Diffusilina papillata* sp. nov. Interior of small specimen showing lobulate chamber. × 42.
 Fig. 5.—*Diffusilina papillata* sp. nov. × 16.
 Fig. 6.—*Diffusilina papillata* sp. nov. × 34.
 Fig. 7.—*Tholosina vesicularis* (Brady), var. *erecta*, var. nov. showing branching tube. × 20.
 Fig. 8.—*Tholosina vesicularis* (Brady), var. *erecta*, var. nov. × 20.

PLATE II.

- Figs. 9, 10.—*Protobotellina cylindrica* gen. et sp. nov. × 3.
 Fig. 11.—*Protobotellina cylindrica* gen. et sp. nov., longitudinal section. × 3.
 Fig. 12.—*Protobotellina cylindrica*, view of aperture. × 12.
 Fig. 13.—*Protobotellina cylindrica*, cross-section of tube. × 12.
 Figs. 14, 15.—*Ammobaculites rostratus* sp. nov. using sand. × 17.
 Fig. 16.—*Ammobaculites rostratus* sp. nov. using mud. × 17.
 Fig. 17.—*Ammobaculites rostratus* sp. nov., immature form. × 17.

PLATE III.

- Figs. 18, 19.—*Ehrenbergina crassa* sp. nov. Megalospheric. Edge view. × 90.
 Fig. 20.—*Ehrenbergina crassa* sp. nov. Megalospheric. Ventral side. × 90.
 Fig. 21.—*Ehrenbergina crassa* sp. nov. Megalospheric. Dorsal side. × 90.
 Fig. 22.—*Ehrenbergina crassa* sp. nov. Microspheric. Ventral side. × 90.
 Fig. 23.—*Ehrenbergina crassa* sp. nov. Microspheric. Edge view. × 90.
 Fig. 24.—*Ehrenbergina crassa* sp. nov. Microspheric. Edge view of specimen in balsam. × 90.
 Fig. 25.—*Ehrenbergina crassa* sp. nov. Microspheric. Ventral side of specimen in balsam. × 90.
 Fig. 26.—*Ehrenbergina crassa* sp. nov. Megalospheric. Ventral side of specimen in balsam. × 90.

PLATE IV.

- Fig. 27.—*Trochammina malovensensis* sp. nov. Side view. × 80.
 Fig. 28.—*Trochammina malovensensis* sp. nov. Ventral view. × 80.
 Fig. 29.—*Trochammina malovensensis* sp. nov. Dorsal view. × 80.
 Fig. 30.—*Trochammina malovensensis* sp. nov. Side view, specimen in balsam. × 80.
 Fig. 31.—*Trochammina malovensensis* sp. nov. Ventral view, specimen in balsam. × 80.
 Fig. 32.—*Trochammina malovensensis* sp. nov. Dorsal view, specimen in balsam. × 80.
 Figs. 33, 34.—*Globigerina cristata* sp. nov. Dorsal view of young specimens. × 200.
 Fig. 35, 36.—*Globigerina cristata* sp. nov. Ventral view of young specimens. × 200..
 Fig. 37.—*Globigerina cristata* sp. nov. Ventral view, adult. × 200.
 Fig. 38.—*Globigerina cristata* sp. nov. Dorsal view, adult. × 200.
 Fig. 39.—*Globigerina cristata* sp. nov. Edge-oral view, adult. × 200.
 Fig. 40.—*Discorbis kempii* sp. nov. Dorsal view, young shell. × 80.
 Fig. 41.—*Discorbis kempii* sp. nov. Dorsal view, young shell. × 80.
 Fig. 42.—*Discorbis kempii* sp. nov. Dorsal view, young shell. × 80.
 Fig. 43.—*Discorbis kempii* sp. nov. Ventral view, young shell. × 80.
 Fig. 44.—*Discorbis kempii* sp. nov. Dorsal view, immature shell. × 60.
 Fig. 45.—*Discorbis kempii* sp. nov. Dorsal view, immature shell. × 60.
 Fig. 46.—*Discorbis kempii* sp. nov. Dorsal view, adult shell. × 50.
 Fig. 47.—*Discorbis kempii* sp. nov. Ventral view, adult shell. × 50.
 Fig. 48.—*Discorbis kempii* sp. nov. Edge view, adult shell. × 50.

XXVIII.—*ECHINUS MILIARIS*.

By W. WALL.

(Read December 18, 1929.)

ONE TEXT-FIGURE.

DURING the dissection of an *Echinus miliaris*, in the laboratory of the Royal College of Science, I found an unmistakable trifoliate pedicellaria between two of the buccal podia. This, I believe, is a rarity unknown in *Miliaris*, and worthy of note.



TRIFOLIATE PEDICELLARIA.

XXIX.—THE FIXING ACTION OF CERTAIN DEHYDRATED CHEMICAL REAGENTS.

By PARIMAL BIKAS SEN, M.Sc., Premchand Roychand Scholar,
Biochemical Department, Calcutta University.

(Read November 20, 1929.)

THE following chemicals were studied in this work: (1) Ethyl alcohol; (2) Methyl alcohol; (3) Acetone; (4) Formaldehyde; (5) Chloroform; (6) Pyridine.

As it was difficult to obtain suitable unfixed dehydrated tissue for studying the action of the above reagents in an anhydrous state, air-dried desiccated blood films were used for this purpose. These blood slides were treated with various dilutions of fixatives with water, and the different degrees of fixation were ascertained by the various stages of de hæmoglobinisation and plasmolysis produced by the subsequent treatment of these blood films with distilled water.

All dehydrated chemicals were carefully prepared and tested for water. The following are the methods adopted for the preparation of these reagents:—

Ethyl and Methyl Alcohol.—Extra pure alcohols were treated with a few beads of carefully cleaned metallic sodium and were distilled with a calcium chloride trap. Only the middle portion of the distillate was collected. This procedure removed the traces of water in alcohols as found by calcium carbide and various other tests.

Acetone.—Pure acetone was kept overnight with fused calcium chloride and was distilled with a calcium chloride trap. Only the middle portion of the distillate was collected.

Formaldehyde.—As formaldehyde is a gas at ordinary temperatures and pressure, and is not used as such for fixing purposes, completely dehydrated acetone was saturated with dry formaldehyde gas. By comparing the actions of dehydrated acetone and the formaldehyde-acetone mixture on the fixation of air-dried blood films, the individual action of formaldehyde may be judged, but it is impossible to find out the action of different dilutions of formaldehyde in this way.

Chloroform.—Chemically pure chloroform was kept overnight with fused calcium chloride and was distilled with a calcium chloride trap in an amber-coloured receiver. Only the middle portion of the distillate was collected.

Pyridine.—Chemically pure pyridine was kept overnight with pure sodium hydroxide sticks and was distilled with a calcium chloride trap in a receiver. Only the middle portion of the distillate was collected.

Well-dried blood slides were placed in a wide-mouthed test tube and completely covered with the fixing reagents. They were kept well stoppered for different periods of time to observe the progress of the fixing action. The slides were taken out of the vessel from time to time and the adhering fixative rapidly blotted off. The dry slides were dipped in distilled water for four to five minutes, and then fixed with methyl alcohol and stained with Giemsa's stain, and the different degrees of dehaemoglobinisation and plasmolysis studied under the microscope.

According to the peculiarities of the fixing action, the reagents may be divided into three classes :—

Class a.—Fixatives which in a dehydrated condition have no fixing action on the blood corpuscles, even when allowed to act for more than an hour. Acetone and chloroform come under this head.

Acetone.—When perfectly dehydrated acetone is used as a fixing reagent, the desiccated blood films can be dehaemoglobinised even after the prolonged treatment of twelve hours. When 98.6 p.c. acetone is used, very imperfect fixation takes place, times below 15 minutes having practically no action at all. But when acetone of slightly lower dilution than 98.6 p.c. is used, the blood corpuscles become fixed very rapidly. Between 80 p.c. to 94 p.c. the rate of fixation attains its maximum. Below this percentage the fixing power again falls steadily until at 60 p.c., when lysis takes place before the dilute acetone has time to fix the blood corpuscles.

The superiority of acetone over many fixing reagents has been claimed by Fuss (1906) and Lintwarow (1911). To obtain acetone in a dehydrated condition they kept some anhydrous copper sulphate in the vessel of acetone. When the fixing action of the dehydrated acetone is taken into consideration, this precaution seems to be immaterial. The excellence of the results claimed by them must have been due to the use of wet tissue instead of well-desiccated blood films. Water inside the tissue must have served the purpose of dilution when acetone diffused inside the cells. So really the fixation is due to this diluted acetone.

Chloroform acts in a similar way. Absolutely dehydrated chloroform has no fixing action on a well-dried film. Addition of 0.3 p.c. water restores the fixing property. 99.5 p.c. is the quickest fixing strength. The fixing property of the various lower dilutions could not be found, owing to the sparing solubility of chloroform in water. Chloroform water is highly haemolytic.

Class b.—They are the fixatives which in a perfectly anhydrous state have some fixing action on well-dried blood corpuscles, but the fixations are very imperfect and uneven. Their fixing power is considerably increased when a small trace of water is added to them. Acetone-formaldehyde mixture and pyridine are examples of this group.

Acetone-formaldehyde mixture.—Acetone saturated with dry formaldehyde gas has very imperfect fixing power. This slight fixing action is due to the action of formaldehyde, as it has been found out that dehydrated acetone

has no fixing action on dry erythrocytes, and so acts inertly in this system. Watery solution of formaldehyde gas fixes blood corpuscles very rapidly.

Pyridine.—Absolutely dehydrated pyridine has very imperfect fixing power. It is necessary to remove completely the adhering pyridine immediately after the slide is taken out of the test tube containing pyridine. As a result of its high boiling point and oily nature, it is difficult to remove it by blotting before it exerts some fixing action on the corpuscles, because any trace of pyridine left on the slide may acquire fixing power due to absorption of water from the atmosphere. So the slides are washed completely free from pyridine by passing through dehydrated acetone. With the addition of a small trace of water, pyridine acquires full fixing power.

Class c.—The reagents of this class fix the dry blood corpuscles in a very short time, and the differences of fixing action between the dehydrated and the diluted fixing reagents are very small. Ethyl and methyl alcohol come under this group.

Ethyl and Methyl Alcohol.—Ethyl and methyl alcohol fix the air-dried blood films almost instantaneously. With the addition of a small percentage of water, the change of the fixing power is hardly distinguishable.

The fixation of these reagents may be explained by the following theory:—

The chemicals of the class *a*, and those of the class *b* to a certain extent, form on the membrane of the air-dried blood corpuscles a thin layer, impermeable to these reagents when they are in a dehydrated condition; but when the percentage of water in these reagents exceeds a certain limit, the condition is altered. Then the layer formed by them on the surface of the corpuscles imbibes a certain amount of water from the fixing fluids, and through the medium of this water the fixing fluids gain access to the cells and fix them.

In the case of acetone and chloroform in a dehydrated condition, penetration of these fixing reagents inside the blood corpuscles does not take place. In the case of acetone-formaldehyde mixture and pyridine a very small amount of fixing fluid gains access inside the cells, but it is quite insufficient to fix the cell elements properly. In the case of ethyl and methyl alcohol in a dehydrated condition the blood cell membranes allow a sufficient quantity to pass through them and fix the cell elements properly.

The following experiments corroborate the above theory and throw some light on the mechanism of fixation.

Experiment 1.—If spirit soluble eosin is dissolved in different dilution of acetone and chloroform, and these solutions are used as fixing and staining fluid, the erythrocytes begin to take the stain only with those strengths of acetone and chloroform which have power to fix the cell elements. For example, the erythrocytes are not stained by eosin solution in 100 p.c. or 90 p.c. acetone or 100 p.c. chloroform, but are easily stained by eosin solution in 96 p.c. acetone or 99.4 p.c. chloroform. Even when well-fixed blood films are used, eosin dissolved in 100 p.c. acetone fails to stain the erythrocytes.

This shows the increase of permeability of cell membranes in the presence of water in the above reagents.

Experiment 2.—To study the power of these reagents of diffusing through dry animal membranes, artificial cells were prepared by coating parchment thimbles with a uniform layer of blood serum. These thimbles were well desiccated in the vacuum desiccator until they were perfectly dry. Dehydrated acetone was then taken inside one of these thimbles and was dialysed against chloroform. Both the thimble and the outer jacket containing chloroform were well stoppered, so that they might not absorb water from the atmosphere and might not contaminate one another through the medium of the air. After two hours the acetone was tested for any trace of chloroform, and the chloroform in the outer vessel was tested for acetone. Both the reagents were found to be uncontaminated by one another. Now a few drops of water were added to the chloroform in the outer tube and to the acetone inside the thimble. After two hours it was found that both the reagents had diffused through the wall of the thimble and had contaminated one another.

Acetone in chloroform was detected by shaking chloroform with water and testing that water for acetone by the nitroprusside test, and chloroform in acetone by the carbyl amine reaction. Both the tests are sufficiently delicate to detect a very small trace of acetone or chloroform.

Repeating these experiments with chloroform and ethyl alcohol, and also with acetone and ethyl alcohol, it was found that when absolute alcohol and dehydrated acetone or chloroform were used, only absolute alcohol diffused through the membrane and mixed with acetone or chloroform, but dehydrated acetone or chloroform could not diffuse through the membrane and contaminate the alcohols. The presence of alcohols in acetone and chloroform was detected with dilute potassium dichromate and sulphuric acid.

If it is assumed that the cell walls of the blood corpuscles behave in the same way as the artificial membrane produced by coating parchment thimbles with a layer of serum, then we get an insight into what takes place during alcohol, acetone, and chloroform fixation. Absolute alcohol has the power of diffusing through dry animal membranes; so when air-dried blood corpuscles come in contact with absolute alcohol, it diffuses through the cell walls and comes in intimate contact with the inner structures and fixes them. But in the case of acetone, chloroform and the like, it is found that when free from water they cannot pass through dry animal membranes, the presence of a certain percentage of water being necessary to make the cell walls permeable to acetone and chloroform. So in the case of dry blood corpuscles, acetone and chloroform do not gain access inside the cells and fix the inner structures unless a certain percentage of water is present in the chemicals.

Experiment 3.—Blood corpuscles were well washed with normal sodium citrate and normal saline and then thoroughly dried in a vacuum desiccator. These corpuscles were ground in a covered mortar with chemically treated sand and anhydrous acetone. It was found that with the progress of grinding fresh surfaces of blood corpuscles became exposed to acetone, and there was

a progressive fixation of hæmoglobin. The degree of fixation was determined by evaporating away the acetone in vacuum as completely as possible, and then extracting soluble hæmoglobin out of it with distilled water and measuring the insoluble proteins left after the extraction. From the ratio of the insoluble proteins with the soluble hæmoglobin it was found that there was a progressive increase of insolubility as the fresh surfaces of hæmoglobin came in contact with the fixing reagents.

The above experiments verify the theory formulated in this paper.

SUMMARY.

According to the fixing action in dehydrated and in slightly diluted condition on erythrocytes, acetone, chloroform, acetone saturated with formaldehyde, pyridine, ethyl and methyl alcohol are divided into three groups.

Acetone and chloroform belong to the first group, and have no fixing action in a dehydrated condition. 98.6 p.c. acetone and 99.5 p.c. chloroform can fix to a certain extent in 15 minutes.

Dehydrated acetone saturated with dry formaldehyde gas and dehydrated pyridine fix very imperfectly and unevenly. Addition of a trace of water improves the fixing property to a remarkable degree. These reagents belong to the second group.

Absolute ethyl and methyl alcohol fix very rapidly. Addition of water does not increase the fixing power to any remarkable degree. They belong to the third group.

The mechanism of fixation may be explained by assuming that the dehydrated chemicals of the first group, and those of the second group to a certain extent, cannot penetrate the dry cell walls unless certain percentages of water are present in them. The process of diffusion inside the cells takes place through the medium of water imbibed by the cell walls.

Certain experiments verify the theory.

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XXX.—A TECHNIQUE FOR THE MICROSCOPICAL EXAMINATION OF WOOL FIBRES.

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(Read November 20, 1929.)

FOUR PLATES.

IN view of the increasing popularity of the microscope as an aid in solving problems arising in the textile industry, and of the necessity of a more thorough understanding of the fibre, attention has been given to the improvement of methods of handling material prior to microscopical examination. Thus, in the case of vegetable fibres, and more particularly cotton, the swelling test of Fleming and Thaysen and the Congo red test of Bright are proving of very great value in ascertaining the condition of the fibres before and after passing through the different manufacturing processes. These tests, however, are not applicable to wool, which, being protein in nature, has, of course, a different chemical constitution. For animal fibres some other test is necessary, and it is the object of this paper to describe a method of preparation in use in the laboratories of the British Research Association for the Woollen and Worsted Industries, which is proving very useful as a means of examining wool in all stages of its manufacture.

The treatment of the wool is essentially that described by von Brunswik, and involves the use of Pauly's reagent, diazobenzene-sulphonic acid, applied in an alkaline solution. For microscopical purposes the fibres are mounted and examined in a somewhat similar manner to that recommended for cotton by Fleming and Thaysen. A brief reference has already been made to this method by Burgess (1928).

PREPARATION AND APPLICATION OF THE REAGENT.

According to the directions given by Pauly, diazobenzene-sulphonic acid is prepared as follows:—

Two gms. sulphanilic acid are stirred up with a mixture of 2 cc. of concentrated hydrochloric acid and 3 cc. of water. A solution of 1 gm. sodium nitrite in 2 cc. water is then added gradually. The precipitated diazobenzene-sulphonic acid is filtered off and washed sparingly. The dry substance is only moderately stable.

Where, however, the test is in constant use, as is the case in our laboratories, it is convenient to employ stock solutions of sodium sulphanilate and sodium nitrite. The reagent is then prepared as follows :—

Five cc. of 8 p.c. sodium nitrite solution is added to 10 cc. sodium sulphanilate, and pure hydrochloric acid (S.G. 1.16) run in, drop by drop, until precipitation of the diazo acid is complete. For the above quantities of sodium salts about 1.2 cc. of acid is required. Precipitation is facilitated by stirring. It is, moreover, advisable to keep the liquid cool, although the use of ice is not essential. The precipitate is filtered and washed, then dissolved in 5 cc. of 10 p.c. sodium carbonate solution and diluted with 5 cc. of water. The solution is applied with as little delay as possible. After from seven to ten minutes immersion, the wool is rinsed until no more colour comes away in the wash water. In this laboratory it is customary, prior to examination, to remove the fat and water-soluble impurities by immersions of the wool, first of all in three consecutive baths of ether, and then in three of warm water, the first of which contains a little Leonil S. If the material is wet at the time of application of the stain, the reagent may be further diluted with water without appreciably altering the depth of shade where such is produced. The writers have never obtained evidence contrary to von Brunswik's statement that the presence of up to 4 p.c. of fat does not interfere in any way with the result. Even still larger quantities of natural wool grease have no adverse effect upon the reaction.

By these means damaged fibres or portions of fibres are stained various shades of yellow or red according to the severity of the injury which they have suffered (*see* plates I and II).

THEORY OF THE REACTION.

According to von Brunswik, the reaction consists essentially of a combination between the diazo compound and the amino acid *tyrosine* (*p*-hydroxy phenyl- α -amino-propionic acid).

Tyrosine, it is stated, although present in the proteins of the cortex, is absent from the scales constituting the epithelium of the fibre. Consequently only when the epithelial scales are damaged can the reagent penetrate to the cortex, where by interaction with tyrosine it produces a localised brown-red colouration at the site of the injury.

It is well known from the work of Pauly, the discoverer of the reaction, and of Pauly and Binz, that not only tyrosine, but also histidine (β -iminazole- α -amino-propionic acid), an amino acid present in nearly all proteins, is capable of giving a colour with diazobenzene-sulphonic acid in alkaline solution which is almost indistinguishable from the colour given by tyrosine. The tyrosine colouration is, however, slightly yellower in shade than that given by histidine. In order to differentiate between the two compounds, Inouye suggested benzoylating the mixture by means of the Schotten-Baumann reaction. Under these conditions tyrosine forms a di-benzoyl



PLATE I.



PLATE II.

derivative which no longer gives any colour with the reagent, whilst histidine, converted into a monobenzoyl derivative, retains this property.

Unfortunately the procedure recommended by Inouye is liable to introduce error on account of the fact, discovered later by Kossel and Edlbacher, that compounds of histidine involving union with the carboxyl group of the latter (such as, for example, the methyl ester or histidine peptides) do not benzoylate as does free histidine, but yield tri-benzoyl-tri-amino-acid derivatives by rupture of the iminazol ring. These compounds no longer give the red colouration with Pauly's reagent. It follows, therefore, that unless the reaction be applied to a histidine-containing protein *after* hydrolysis, only those histidine molecules which were so arranged in the protein that their terminal carboxyl groups were free would be capable of giving a positive reaction according to Inouye's modification of the test.

From all points of view the practical distinction between tyrosine and histidine in proteins by means of diazobenzene-sulphonic acid was unsatisfactory until the work of Totani appeared. Totani showed that whereas tyrosine, histidine, and, to a lesser degree, cystine, valine and many of the naturally occurring amino acids give practically identical brown-red colours with the Pauly reagent, only tyrosine and histidine yield a "secondary" colouration after reduction of the first formed dye-stuff by zinc and hydrochloric acid and addition of ammonia until alkaline. Tyrosine under these conditions gives a deep rose-red secondary colouration, whilst that due to histidine is golden yellow. Other amino acids give no secondary colour at all. In this form the reagent becomes a very valuable instrument in distinguishing between tyrosine and histidine.

Von Brunswik states that histidine is absent from wool keratin. However, although no report was made upon histidine in the analysis of sheep's wool by Abderhalden and Voitinovici, the recent work of Marston has shown that histidine is actually present in wool keratin to the extent of 6.9 p.c. Consequently, since the Pauly staining reaction of damaged wool has always, so far as we know, been attributed to tyrosine, it seemed of interest to us, for a complete understanding of this test, to investigate the secondary colours which could be obtained by using the Totani technique.

Totani showed that diazobenzene-sulphonic acid possesses a far greater affinity for histidine than for tyrosine. When a limited quantity of the reagent was added to a mixture of these two amino acids, it was possible to observe reaction proceeding first of all with the histidine present, the characteristic rose-pink secondary colour of tyrosine appearing only when a relative excess of reagent was employed.

Since, in applying the Pauly test to wool, it is our practice to use a large excess of the reagent, it would be expected that both tyrosine and histidine would react. If this were so, on oxidising the secondary colouration with hydrogen peroxide, that due to tyrosine would disappear, leaving only the lemon-yellow secondary colour of histidine which is stable towards this oxidising agent.

A lock of wool showing moderately severe damage was stained by the Pauly reagent. Whilst still moist, it was transferred to a beaker containing 5N hydrochloric acid. Zinc dust was then added, and the wool allowed to remain in contact with the effervescing mixture for fifteen minutes. After rinsing in water, the lock, which had now a yellow colour, was transferred to another beaker containing 20 p.c. ammonia.

The mass of wool at once assumed a bright rose-pink colouration, the intensity being greatest in those regions which had previously shown evidence of most severe damage. The appearance of the pink secondary colour is clearly indicative of the presence of tyrosine as one of the reacting substances.

On transference of the wool to a beaker of hydrogen peroxide solution (50 vols.), the pink colour rapidly disappeared from the entire lock, with the exception of a few fibres which were still of a dark red shade.* After ten minutes immersion the wool was removed and rinsed. It was uniformly stained a light golden colour. This shade resembled that given by histidine in solution.

As a working hypothesis, we are prepared to accept the view that the Pauly reagent only stains wool where damage has resulted in a displacement or rupture of the epithelial scales, but the evidence of the experiment quoted above seems to us to afford reliable indication that not only tyrosine but histidine also is concerned in the reaction with Pauly's reagent, causing the characteristic reddish-brown stain where damage has occurred.

PROPERTIES OF WOOL TREATED WITH THE STAIN.

The selective property which the test exhibits renders it very sensitive, and gives an accurate and reliable indication of the condition of the fibre at any particular stage of its history. Thus, for instance, the test shows very forcibly that a by no means inconsiderable portion of every fibre is severely damaged at the time it is clipped (*see* plates III and IV). This injury, which evidently occurs while the wool is still on the sheep, is usually confined to the tip, and varies in extent from lengths of about $\frac{1}{8}$ in. in high quality merino wool to as much as 3 ins. in low crossbreds. In addition, evidence of a definite though less extensive damage is often apparent throughout the entire length of certain samples of lower quality wools, while in skin wool the basal extremities of the fibres are usually badly damaged. The presence of the "dead" thick-ended fragments and heterotype fibres which are to be found in the majority of raw wools is also readily observed, since they are always deeply stained during treatment with the reagent. Further, such fibres are found to persist even in the finished cloth. Hence by furnishing a true picture of the physical conditions of the raw wool fibre, the test

* It was observed that these fibres presented a characteristic appearance which included marked thickening at the tips. This occurrence will be referred to later on in the next section.

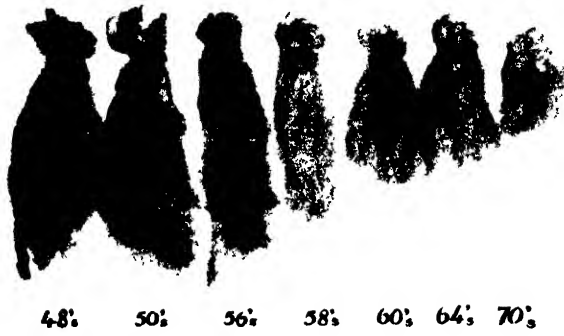


PLATE III.



PLATE IV.

can be of great use in investigating many practical problems the elucidation of which has, up to the present, been a matter of great perplexity.

As regards processed wool, it is now generally agreed that the injurious effect on the fibre of any specific treatment in the mill depends largely on the initial condition of the raw material, and especially the protective value of the epithelial scales. Where the fibre scales are injured, the subsequent action of mechanical or chemical agents is most pronounced. When these agents have been applied in too drastic a manner, such as in over-scouring or over-carbonising, the wool, on treatment with the diazo reagent, assumes a deep shade of colour which contrasts markedly with the hue of normally treated wool of the same kind. Thus defects in processing can be detected with ease, with a corresponding saving of time and trouble in the mill. The colour shade exhibited by fibres in a compact form, as in roving, yarn or woven cloth, is somewhat deeper and more homogeneous than that of the more loosely constituted tops from which the roving was drawn. Such materials invariably show a considerable amount of damage, the extent of which it is possible to grade by means of arbitrary standards of colour intensity. This method has been found useful in investigating the effect of certain finishing processes such as milling and chlorination, both of which result in serious damage to the goods if not properly carried out (*see plate IV*).

MICROSCOPICAL EXAMINATION.

The method adopted by von Brunswik for the microscopical examination of wool treated with Pauly's reagent was a classification of the fibres into five groups according to the extent and localisation of the damage which they had undergone. Briefly, these may be summarised as follows:—

Group I.—Intact fibres showing positive staining only at the cut ends.

Group II.—Nearly intact fibres.

Group III.—Fibres showing local mechanical injury.

Group IV.—Fibres severely damaged for one quarter to half of their entire length.

Group V.—Completely damaged fibres, uniformly stained deep red.

A large number of samples of wool treated in various ways, such as by scouring and by carbonising, were examined, adopting these standards of measurement, and very useful information obtained regarding the specific action of such processes on the fibres.

A serious drawback to von Brunswik's method is to be found, however, in the time-consuming operation of examining completely some hundred fibres drawn from a representative sample of the treated wool. The present authors have found it more convenient to employ the microscopic method of Thaysen and Bunker, whereby only portions of individual fibres are examined. For this purpose a bundle (about 1 in. to 1½ in. long) consisting of portions of treated fibres is wetted out in dilute albumen fixative and placed on one end of a glass slide. A film of the same fluid is then spread on the other half

of the slide, and about twenty of the fibre portions arranged in a parallel manner with the aid of two dissecting needles. A cover-slip $\frac{3}{4}$ in. square is then placed on the fibres so arranged, and a drop of water allowed to spread beneath it. Examination of individual fibre units, each corresponding to the diameter of the microscopic field, is then made by adjustment of the mechanical stage, the units being considered to be positive or negative according to whether they are deeply coloured and at the same time show definite visible evidence of structural damage, or, on the other hand, are entirely free from stain. In addition, an intermediate group is considered which is composed of potentially positive units, i.e. portions of fibres which show a pale yellow colour corresponding to a slight loosening or "thinning" of the scales. An exact number of units, usually a thousand, involving the use of five slides, is examined, and the results expressed as a percentage of the whole. With practice, and especially if two persons are available, the one to observe and the other to record the results on squared paper, the time taken to deal with one sample of previously stained wool can be reduced to about twenty minutes.

The following table, which gives the results obtained for seven different qualities of Tasmanian wool originating from one flock of sheep, is appended as an instance of how this method of microscopical examination can be applied (*see also plate III*). In passing, it will be observed that the lower grade wools are more extensively damaged than the finer qualities. The method is also being used with success in investigations on the action of micro-organisms on wool.

TABLE I.—MICROSCOPICAL EXAMINATION OF TASMANIAN FLEECE WOOL.

Number of units examined, 1000. (Field diameter, i.e. one unit = 1 mm.).

Number.	Quantity.	Reaction to diazobenzene-sulphonic acid.		
		Negative.	Potentially Positive.	Positive.
		Per cent.	Per cent.	Per cent.
1	48's	33·1	63·9	3·0
2	50's	47·2	49·7	3·1
3	56's	38·7	59·0	2·3
4	58's	78·3	21·1	0·6
5	60's	72·1	24·9	3·0
6	64's	73·3	24·7	2·0
7	70's	73·3	24·4	2·3

SOME POSSIBLE CRITICISMS AS TO THE SUITABILITY OF THE REAGENT.

Whilst recommending the diazo test, mention should be made of its shortcomings. In the first place the test is essentially a colour reaction, and cannot be applied to naturally coloured or dyed fibres. Attempts to strip completely the colour from dyed fibres invariably result in superficial damage, and, as far as the writers are aware, the condition of coloured fibres may best be ascertained by ordinary microscopic examination.

A somewhat greater disadvantage, from the point of view of those who are using the test for routine examination, is the fact that the diazo acid is too unstable to keep made up in stock solution. For this reason Sieber prefers to use Benzopurpurin 10B, which keeps indefinitely in aqueous solution, and gives with damaged wools a depth of pink or red comparable in range with the tints obtained when using the Pauly reagent.

As is the case with other dyestuffs of a similar class, Benzopurpurin 10B is much more readily absorbed by wool when mineral acid is present, hence the necessity, in our opinion, of a preliminary neutralisation of any sample of wool to be tested. Furthermore, a temperature of 70° C. would seem to be more suitable than the boiling temperature recommended by Sieber, since contrasts in the shades produced at the lower temperature are much more easily appreciated. The above manipulation would, it must be remarked, involve the use of a thermo-regulator.

For microscopical work of an extended nature, the tint of the Pauly-stained fibres is infinitely superior.

In conclusion, the writers wish to thank Mr. J. Stott for assistance rendered during the course of this work.

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EXPLANATION OF PLATES.

Samples of Wool stained with Diazobenzene-sulphonic Acid.

Plate I.—Merino wool fibres damaged by *Aspergillus fumigatus* $\times 200$. (Photographed on orthochromatic plate.)

Plate II.—The same photographed on panchromatic plate with Wratten filter No. 58.

Plate III.—Series of Tasmanian wools (composite samples) of various qualities. Tips removed prior to staining.

Plate IV.—Raw and processed wool.

1. 48's Tasmanian.
2. 50's Hog "Albury" wool.
3. 64's Tasmanian.
4. 80's Victoria "Geelong."
5. 60's commercially scoured cloth.
6. Specially finished wool flannel (not carbonised and not scoured).
7. Specially finished wool flannel (treated with bisulphite and milled).
8. Specially finished wool flannel (chlorinated and then treated with bisulphite and milled).

XXXI.—ON THE THEORY OF THE REFLECTING CONDENSER FOR DARK-FIELD ILLUMINATION.

By HENRY F. W. SIEDENTOPF, D.Ph., D.Eng.

(*Read November 20, 1929.*)

TWO TEXT-FIGURES.

J. SMILES and J. E. Barnard in 1924 published a paper on reflecting condensers, and more especially on their optical correction by trigonometrical calculation. To the present author it seems desirable to extend further the investigation by taking account of the influence of the thickness of the object slide and of the finite distance of the source of light, and also to develop a comprehensive formula for determining the configuration of the reflecting condensers in the place of the method of computation by trial.

It is well known that microscope objectives are increasingly affected by the tube-length in a measure as the numerical aperture increases. Since, now, we look upon the condensers as enlarged objectives in which the course of the rays is reversed, it follows that the same applies to them, and hence they should be computed for a certain finite distance (about 300 mm.) of the radiant field-stop which operates as the source of light, and they should be used accordingly.

Hence also the well-known relation (Gehhoff 1926) between the performance of the dry lenses and the thickness of the cover-glass should be expected to have its counterpart in those condensers which are used without an immersion medium in the matter of the influence exercised by the thickness of the object slide. Actually many forms of the reflecting condensers, such as the dissecting condensers for use with the micro-manipulator and the gas condenser, are used without immersion—that is to say, dry. The object slide then behaves like a plane-parallel plate and produces accordingly a degree of over-correction which depends upon the angle of incidence. This degree of over-correction requires to be balanced, at least to the extent of a mean value, by an appropriate amount of under-correction in the reflecting condenser in the event of its exit surface not being a plane surface.

It is customary to give the exit surface of those reflecting condensers which are used without immersion a spherical form having its centre of curvature in the image point of the condenser, this point coinciding with the position of the object. In what follows we shall distinguish this surface from other spherical surfaces by referring to it as an auxiliary spherical surface S' . It is traversed by rays which are perpendicular to it.

The form of the reflecting condensers may be ascertained in two ways, viz., geometrically and analytically. The geometrical solution is shown in fig. 1. Let QF be the axis of the microscope. Let the object be situated at F and let Q denote the position of the radiant field-stop which functions as the source of light, such as the iris-diaphragm in a tungsten arc lamp, an image of which is to be formed by the reflecting condenser in the plane of the object. From Q let a ray proceed at any angle ϕ , which usually is very small, though not necessarily so, and let this ray meet the first convex

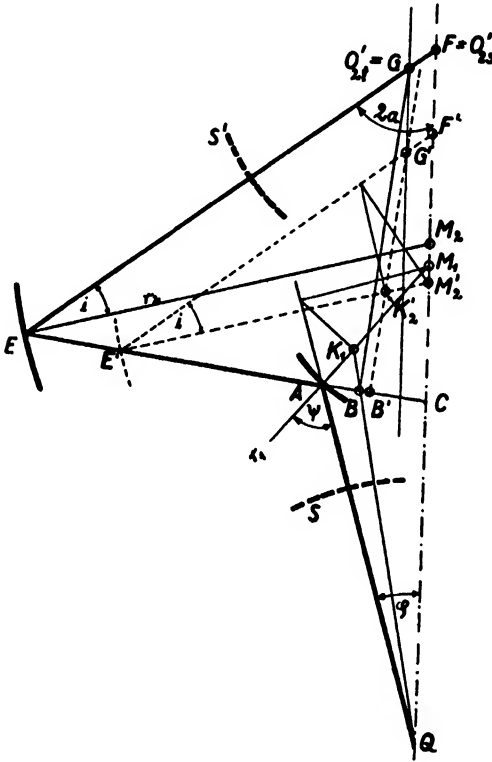


FIG. 1.

reflecting surface at A at any angle of incidence ψ . Also the radius $AM_1 = r_1$ of this convex reflecting surface may be given any desired value. To begin with, draw the reflected ray to any point E' . We may then draw the ray $E'F'$ reflected at the second concave surface in such a way that it may meet the axis at any prescribed angle, which we will denote by 2α . The bisector of this angle then furnishes the radius $E'M_2 = r'_2$.

In general, this does not suffice to determine the correct position of the second reflecting surface. This is governed by the condition that the reflection is required to furnish anastigmatic pencils—that is to say, the astigmatism arising from the reflection at the first reflecting surface is required to be

removed by the second reflection. Now, we know that the first reflection gives rise to two image lines of Q, the so-called sagittal (secondary focal) image line, which is situated upon the first ray produced backward as far as the point of intersection C with the axis, and the meridional (primary focal) image line. The latter may be determined by the following simple construction. From M_1 let fall a perpendicular upon the incident ray QA, and again from its foot let fall a perpendicular upon the radius AM_1 and let it meet it at K_1 . The line QK_1 joining the two points intersects the reflected ray AC produced backwards along the meridional image line B. In order to verify whether the second reflection corrects the astigmatic difference BC, an analogous construction may be applied to this second reflection. From the second centre M_2 let fall a perpendicular upon the second reflected ray $E'E'$ and again from its foot a perpendicular upon the second radius $E'M'_2$, and let it meet the latter at K'_2 . We propose to deal at once with the general case in which the condenser is required to have a prescribed under-correction of the magnitude $G'T''$, i.e. where the meridional image line G' is required to be at this distance from the sagittal image line F' . The line joining $G'K'_2$ meets the first reflected ray $E'A$ produced backwards at B' . The difference BB' indicates that the desired anastigmatic correction has not yet been effected by the two reflections. This may be ascertained by drawing through B a line parallel to $B'G'$, which meets at G a line drawn through G' parallel to the axis. Through G let a line be drawn parallel to $B'G'$, which on the first reflected ray furnishes the point E and on the axis the point F, the latter being the position of the sagittal image line. The bisector of the angle FEC furnishes the second correct radius $EM_2 = r_2$. This supplies the geometrical solution of the problem. Instead of leaving the first radius r_1 unchanged and adapting the second radius r_2 so as to satisfy the required anastigmatic correction, the radius r'_2 may be left unchanged while proceeding to find a new point Q' on the axis for the position of the radiant field-stop by drawing through B' a line parallel to BQ, and, ultimately, by an analogous construction of parallels in the reverse order, the first radius r_1 might then be varied so as to furnish anastigmatic reflection in conjunction with r'_2 .

It must be admitted that such a graphic method of construction supplies a good general idea of the approximate form of the condenser which is being evolved, whereas for the actual production of such a condenser the graphic results are too inexact. It is scarcely practicable to achieve a degree of accuracy within the third place of decimals, whereas in actual production a degree of precision within the fifth decimal is needed. For this reason it is necessary to deal with the problem analytically.

The condition that the astigmatic differences due to reflection require to be equal in magnitude at once furnishes the equation :

$$AC - AB = EC - EB \text{ or } EB = EC - AC + AB \quad . \quad . \quad (1)$$

From the figure it follows that

$$EC \sin 2(i + \alpha) = r_2 \sin(i + 2\alpha) \quad . \quad . \quad (2)$$

and, putting

$$AC \sin 2(i + \alpha) = h, \quad . \quad . \quad . \quad . \quad (3)$$

where h is the distance of the incident ray from the axis of the microscope, i.e. half the aperture of the condenser, it further follows that

$$EC - AC = \frac{r_2 \sin(i + 2\alpha) - h}{\sin 2(i + \alpha)}.$$

From known equations (Siedentopf 1926) for astigmatic reflections it follows further, with respect to the reflection at the convex surface, that

$$AB = eq, \quad . \quad . \quad . \quad . \quad . \quad (4)$$

where $e = AQ$ is the distance of the radiant field-stop measured along the incident ray, and

$$q = \frac{r_1 \cos \psi}{2e + r_1 \cos \psi} \quad . \quad . \quad . \quad . \quad . \quad (5)$$

Introducing the abbreviation

$$u = h - eq \sin 2(i + \alpha), \quad . \quad . \quad . \quad . \quad (6)$$

we obtain the following expression for the reflection at the convex surface :

$$EB = \frac{r_2 \sin(i + 2\alpha) - u}{\sin 2(i + \alpha)} \quad . \quad . \quad . \quad . \quad (7)$$

The reflection at the concave surface may now be investigated by tracing a ray in the inverse order, after which the two reflections may be combined to form a single anastigmatic result. Denoting the prescribed under-correction GF by Δ , we find by the known formula

$$\frac{1}{EB} + \frac{1}{EF} - \frac{2}{\Delta} = \frac{2}{r_2 \cos i} \quad . \quad . \quad . \quad . \quad (8)$$

From the figure it follows that

$$EF \sin 2\alpha = r_2 \sin(i + 2\alpha) \quad . \quad . \quad . \quad . \quad (9)$$

and putting

$$\Delta \sin 2\alpha = v \quad . \quad . \quad . \quad . \quad (10)$$

the reflection at the concave surface is expressed by the equation

$$\frac{1}{EB} = \frac{2r_2 \sin(i + 2\alpha) - r_2 \cos i \sin 2\alpha - 2v}{r_2 \cos i [r_2 \sin(i + 2\alpha) - v]} \quad . \quad . \quad . \quad (11)$$

Now, since the first and second reflections are required to furnish like values of EB_1 , we obtain by the multiplication of equations (7) and (11) a quadratic equation for r_2 , which furnishes the following root :

$$r_2 = \frac{B + \sqrt{B^2 + AC}}{A}, \quad . \quad . \quad . \quad . \quad . \quad (12)$$

where

$$A = 2 \sin^2 i \sin^2 (i + 2a) \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (13)$$

$$B = (u + v) \sin (i + 2a) - \frac{\cos i}{2} [v \sin 2(i + a) + u \sin 2a] \quad . \quad (14)$$

$$C = -2uv \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (15)$$

In general, the quantities i , $2a$, e and h may be given any required values. Then

$$\sin \phi = \frac{h}{e} \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (16)$$

$$\psi = i + a + \frac{\phi}{2} \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (17)$$

$$\sin (\psi - \phi) \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (18)$$

With the aid of these quantities and equation (15) the radius r_2 may be calculated, which furnishes the required anastigmatic reflection having the prescribed under-correction Δ .

The corresponding distance between the centres $M_1 M_2 = b$ follows from the figure :

$$b = \frac{r_1 \sin \psi - r_2 \sin i}{\sin 2(i + a)} \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (19)$$

b becomes negative when M_2 is nearer F than M_1 , as in fig. 1. The freedom obtaining in the choice of the angle i may be employed to so determine it that the curve of aberration for various values in the vicinity of the prescribed value of $2a$ becomes so favourable as to admit of the union of three rays in the image, so that an anastigmatic image point obtains for two simultaneous angles of convergence.

In special cases the formula (15) may be simplified. In the event of the reflecting condenser being used on the immersion principle, the auxiliary spherical surfaces may be dispensed with, and the condenser then will have a plane exit surface. The prescribed under-correction vanishes and $v = 0$, hence also $C = 0$ and

$$r_2 = \frac{2B}{A} \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (20)$$

$$2B_{(v=0)} = uw, \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (21)$$

where by way of abbreviation

$$w = 2 \sin (i + 2a) - \cos i \sin 2a \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (22)$$

In the other special case considered by Smiles and Barnard, the source of light is at an infinite distance and $\phi = a$. In this case we have simply

$$eq = \frac{r_1 \cos (i + a)}{2}$$

and

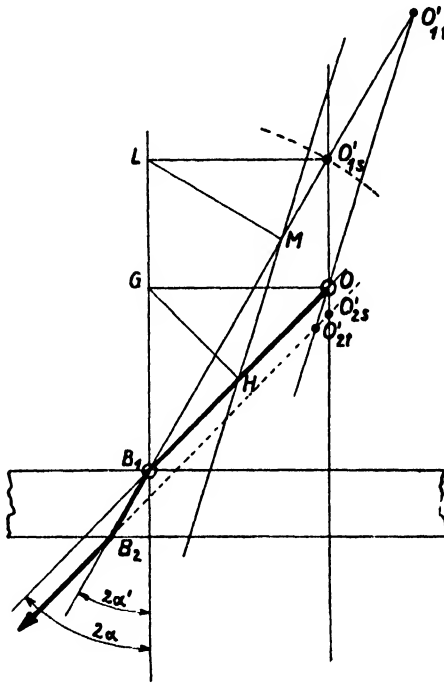
$$w_{(e=a)} = r_1 \sin^3 (i + a) \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (23)$$

For this special case with the radiant field-stop at infinity we have the simple resulting formula

$$r_2 = \frac{r_1 \cdot w \cdot \sin^2(i + \alpha)}{A}, \quad . \quad . \quad . \quad . \quad (24)$$

which I have already enunciated on a previous occasion (Siedentopf 1912).

It may be interesting to know that the calculation of the anastigmatic reflecting condenser here described, which is based upon the principle of the reversibility of the optical paths, when applied to the two last-mentioned special cases, admits also of an interchange of the positions of the object



and the radiant field-stop. Hence, proceeding from the radiant field-stop, the first reflection may be made to occur at the concave surface and the second reflection at the convex surface. This second case furnishes, however, generally speaking, a somewhat less favourable aberration curve than the customary first case, as here discussed.

In conclusion we will append a simple geometrical and analytical method of determining the astigmatic difference which is occasioned by the object slide when the condenser is used without homogeneous immersion and when the plane exit surface is replaced by an auxiliary spherical surface S' ground concentrically with the image point.

The geometrical conditions are explained in fig. 2, in which the path of

the rays is drawn in the reverse order of their actual course. Let O denote the position of the preparation and let the ray OB_1 proceed from it at an angle 2α to the axis. Let it meet at the plane-parallel plate, through which it undergoes refraction and from which it emerges at B_2 in a direction parallel to its original direction. The first refraction at O_1 gives rise to the two astigmatic image points O'_{1s} (sagittal) and O'_{1t} (tangential or meridional), which may be found by the following construction. About B_1 let a circle be described with the radius $n_1 B_1 O$, where n_1 is the refractive index of the plate referred to the outer medium. Let this arc of a circle meet at O'_{1s} the normal let fall from O upon the plate and produced backwards. Upon the normal described at B_1 upon the plate let fall another normal from O'_{1s} and again from its foot L let a normal be described upon the refracted ray $B_1 B_2$ produced backwards. Let its foot be M . Similarly, from O let a perpendicular be described upon LB_1 , and again from its foot G a perpendicular upon the incident ray OB_1 , which furnishes the point H . Through O let a parallel be drawn to MH and let it meet the refracted ray produced backwards at O'_{1t} , which represents the virtual meridional image-line after the first refraction. Through B_2 let a parallel be drawn to the incident ray OB_1 , and let it meet the axis in the second sagittal image-line O'_{2s} and the parallel OO'_{1t} in the second meridional image-line O'_{2t} . The astigmatic difference occasioned by the plane-parallel plate is equal to the segment $O'_{2s} O'_{2t} = \Delta'$. After refraction through the plane-parallel plate the ray passes unrefracted through the auxiliary spherical surface from air into the glass medium of the condenser. Hence for the requisite under-correcting effect of the condenser we find the astigmatic difference to be

$$\Delta = \frac{\Delta'}{n'},$$

where n' is the refractive index of the glass of the condenser referred to the external medium. The entrance surface of the condenser ought to be also an auxiliary spherical surface S (fig. 1) concentric with the radiant field-stop. It may, however, without committing a serious error, be replaced by a plane surface so long as the angle of incidence remains sufficiently small on this side. It is, however, to be noted that in this case, when the condenser has a plane entrance surface, the air-gap e should be increased n' -fold.

The analytical expression for the so-called astigmatic difference Δ' has been shown by Czapski and Eppstein to be

$$\Delta' = \frac{d}{n' \cos 2\alpha'} \left[1 - \left(\frac{\cos 2\alpha}{\cos 2\alpha'} \right)^2 \right], \quad . \quad . \quad . \quad . \quad (25)$$

where $\sin 2\alpha = n' \sin 2\alpha'$, while d is the thickness of the object slide. In view of the pronounced effect which the angle of convergence 2α exercises upon the value of Δ' , it follows that condensers of this form are not likely to be employed excepting within a narrower range of convergencies than is advantageous with other forms involving the principle of homogeneous immersion ($\Delta' = 0$).

Incidentally it may be noted that the latter may be so well corrected with the aid of the formula (20) that the aberration of the focal intercept

$$M_2 F = 2 = \frac{r_2 \sin i}{\sin 2\alpha}, \quad . \quad . \quad . \quad . \quad (26)$$

regarded as a function of 2α , requires to be calculated to the sixth decimal in order to show any appreciable value, even within a range of convergence extending from 42° to 62° , say. This arises from the fact that the required anastigmatic reflection causes the principal rays to be such that the first differential coefficient of the focal intercept z with respect to the angle of convergence 2α vanishes.

Actually we derive from the equation $\frac{dz}{da} = 0$ the simple relation

$$\frac{di}{da} = 2 \tan i \cot 2\alpha \quad . \quad . \quad . \quad . \quad (27)$$

$$\left(\frac{dz}{da} = 0\right)$$

It may suffice to consider only the abridged computation for the special case of an infinitely distant radiant field-stop as applied to reflecting condensers used on the immersion principle (for which $\Delta' = 0$).

Introducing the abbreviations

$$\frac{r_2}{r_1} = \rho \text{ and } \frac{b}{r_1} = \beta,$$

since $\phi = 0$ and therefore $\psi = i + \alpha$, then by (19)

$$\beta = \frac{\sin(i + \alpha) - \rho \sin i}{\sin 2(i + \alpha)} \quad . \quad . \quad . \quad . \quad (28)$$

Since for any given reflecting condenser β and ρ have fixed values, we find by differentiation from (28)

$$\rho \cos i \frac{di}{da} = \left(1 + \frac{di}{da}\right) \cos(i + \alpha) - 2\beta \left(1 + \frac{di}{da}\right) \cos 2(i + \alpha) \quad . \quad (29)$$

Eliminating from this equation with the aid of equations (27) and (28) the values of $\frac{di}{da}$ and β , we obtain by simple reduction in this way likewise an end formula agreeing with (24) for the ratio ρ of the radii of the required reflecting condenser, which by the introduction of the abbreviating symbols w as defined in equation (22) and A as defined in equation (13) may be written in the form

$$\rho = \frac{w \cdot \sin^3(i + \alpha)}{A} \quad . \quad . \quad . \quad . \quad (30)$$

It will thus be seen that the extreme value of the spherical aberration curve arrived at by the removal of the spherical aberration is the same as that resulting from the endeavour to secure an anastigmatic image. We have, however, in the general treatment of the problem given preference to the method which aims at the establishment of the anastigmatic condition, as thereby we obtain a better parallel between the geometrical and the analytical modes of treatment.

In order to give a convenient conception of the degree of correction which results, we append a table which gives for angles of convergence 2α ranging from 48° to 62° the values of the focal intercept

$$\zeta = \frac{2}{r_1}$$

calculated to the sixth place of decimals. Calculating for a certain mean value of the angle of convergence

$$2\alpha = 57.874^\circ$$

and the angle of reflection

$$i = 32.128^\circ$$

by equations (30) and (28) the values of ρ and β , we proceed further to calculate for a number of values of $(i + \alpha)$ after the following simple scheme

$$(a) \sin i = \frac{\sin(i + \alpha) - \beta \sin 2(i + \alpha)}{\rho}$$

$$(b) \alpha = (i + \alpha) - i.$$

$$(c) \zeta = \frac{\rho \sin i}{\sin 2\alpha}.$$

The table further comprises the focal length

$$\frac{f}{r_1} = \frac{\sin(i + \alpha)}{\sin 2\alpha},$$

which exhibits a continuous variation in the values, in that these diminish as the angle of convergence increases. The total decrease within the range considered amounts to about 5 p.c. In the case of modern reflecting condensers of high aperture the range is much smaller, so that the deviations in the focal length become still smaller in amount.

$i + \alpha.$	$2\alpha.$	$\frac{f}{r_1}.$	$\zeta.$
$^\circ$	$^\circ \quad ' \quad ''$		
47	48 08 30	1.07	0,954,564
49	45 08 08	1.06	595
51	47 09 29	1.05	758
53	49 12 41	1.05	768
55	51 17 55	1.05	746
57	53 25 26	1.04	682
59	55 35 23	1.04	684
61	57 48 02	1.03	604
63	60 03 38	1.03	642
65	62 22 23	1.02	800

The value of the back focal distance f holds good for rays passing through air. In the reflecting condenser referred to, the medium is generally glass or oil having a refractive index n' , in which case the value of f requires to be divided by n' .

Though this departure in the focal length is insignificant and practically negligible in so far as illuminating devices are concerned, it yet marks a characteristic difference between the anastigmatic bispherical reflecting condensers here considered and the strictly aplanatic combinations in which the concave spherical surface is replaced by a mathematically computed surface of rotation having in the meridional section a cardioid for its generating curve.

A strictly aplanatic combination (Siedentopf 1909) of this kind has for all angles of convergence, not only the same focal intercept, but likewise the same focal length.

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OBITUARY.

RAY LANKESTER.

By EDWARD HERON-ALLEN, F.R.S., F.R.M.S.

“Howl, dogs! A Wolf has died to-night.”

I THINK that, to the minds of many of us, this cry, wrung from the heart of Phao over the body of Akela the Lone Wolf, must have sprung instinctively and irresistibly. Though the end had been in sight for a long time for those who were admitted to the intimacy of this great gentleman and loyal friend, its final announcement was required to make us realise in all its full significance the blackness of the void left by the removal of his bodily presence from our midst. For fifty-seven years—ever since he first lectured as a Fellow of Exeter College in 1872—the forceful personality and urgent influence of Ray Lankester had been factors to be reckoned with and relied upon in the world of zoological science, factors increasing in significance and value year by year until his retirement, on attaining the age of sixty, from the Directorship of the Natural History Museum in 1907. Even after that, until his last illness had wearied and forced well-earned rest upon his gigantic intellect, his personal influence, helpful, kindly, good-naturedly critical and even caustic, but ever encouraging to those who took counsel with him, remained, always in the background and often in the forefront of scientific thought, and so survived until his death, in his eighty-third year, on the 15th August, 1929, admittedly the greatest and most widely celebrated zoologist of his era.

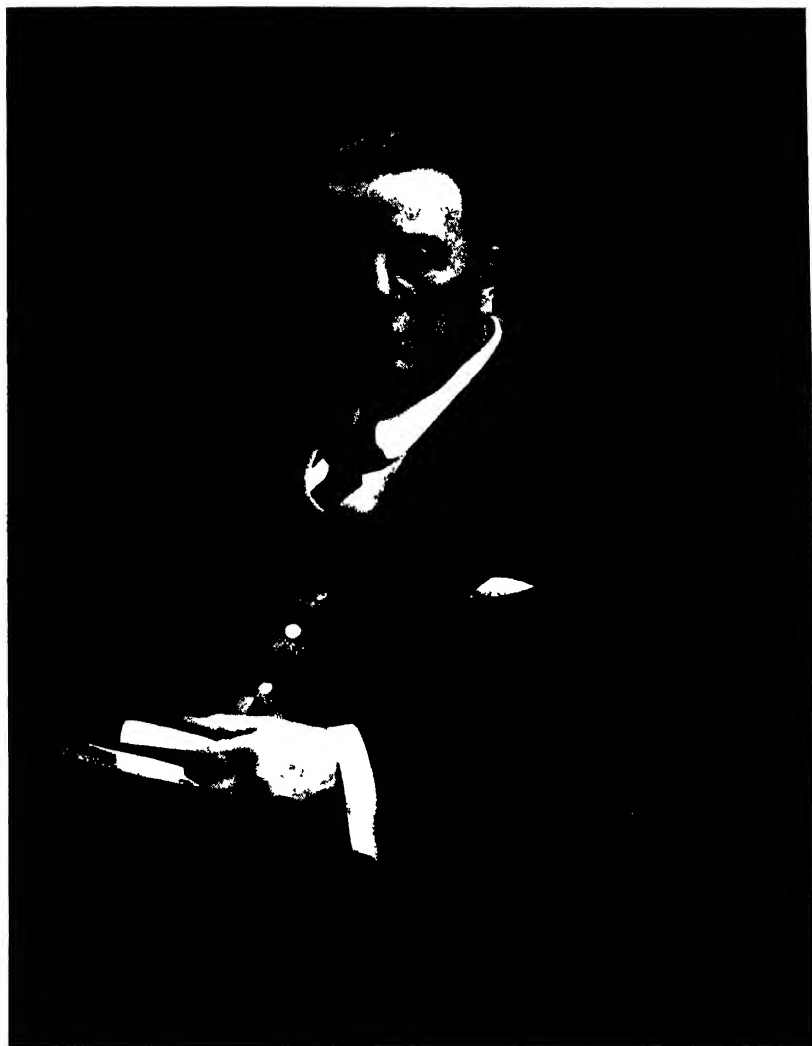
My acquaintance with him, which had hitherto been slight, ripened into friendship on and after the first Sunday in July, 1891, when my wife—to whom I had been married just four days—and I lunched with him at his house in Bradmore Road, Oxford. He was an old friend of my wife's family—she was a daughter of Rudolf Lehmann—and from that moment he befriended me and followed with helpful interest my work upon the Foraminifera, and as time went on, and to the end of his life, our intimacy grew ever closer and closer. I shall speak later of his never-failing sympathy with younger men devoting themselves to science—many of his biographers have referred to this trait in his character—I personally benefited by it from that moment until the end.

The personal charm of Ray Lankester shone forth in whatsoever company he found himself, but perhaps he was at his most lovable best with children.

He was untiring in his efforts to amuse and interest them, and he understood and played up to their joys and sorrows in a manner that can only be described as beautiful. Indeed, he often reminded me of the lines written by William Winter on the death of Ada Clare :

There was no sorrow on this earth
But touched her heart,
And in all gentle childlike mirth
She bore her part;
There was no goodness but it won
Her reverent praise,
And full of good deeds kindly done
Were all her days.

The biographical sequence of his career as a zoologist, and the stations upon the broad and varied road of biological science upon which he left his indelible mark, have been set forth and discussed already in obituary notices in many publications, scientific and otherwise, and these will without doubt be fully dealt with in his biography when it comes to be written ; they need not, therefore, detain us save in the shortest form. Edwin Ray Lankester, K.C.B., F.R.S., M.A., D.Sc. (Oxon.), LL.D. (St. Andrews), D.Sc. (Leeds), Honorary Fellow of Exeter College and Honorary Student of Christ Church, Oxford, member of the Institut de France, foreign, corresponding or honorary member of most of the scientific and learned societies and academies of the world, was born at 22, Old Burlington Street, London, in 1847, the eldest son of Dr. Edwin Lankester, Coroner for Central Middlesex, a well-known physician of scientific tastes, an F.R.S., Secretary of the Ray Society, President of the Microscopical Society of London, and joint editor of the *Quarterly Journal of Microscopical Science*. His mother was a sister of the distinguished Parliamentary barrister, Samuel Pope, and was a brilliant woman and accomplished writer. At the age of eleven Ray Lankester went to St. Paul's School, where he took many classical prizes and won cups for sculling and the long jump. At the age of seventeen he went to Downing College, Cambridge, with a scholarship, but in his second year migrated to Oxford and gained a junior studentship at Christ Church. He graduated at Oxford with first-class honours in Natural Science, gained the Burdett-Coutts Scholarship in Geology and the Radcliffe Travelling Fellowship in 1870, then worked at zoology in Naples, and became Fellow and Lecturer at Exeter College in 1872. In 1874 he was appointed Professor of Zoology at University College, London. He was elected a Fellow of the Royal Society in 1875, and was awarded a Royal Medal in 1885 and the Copley Medal in 1913. He served four times upon the Council and twice as Vice-President, and, so long as scientists now living survive, his non-election to the Presidency, on more than one occasion when he was the most clearly indicated candidate for that exalted position, will be regarded by the great majority of them as a stain upon the history of the Society, as it is now, and has been for many years, a source of helpless amazement to foreign colleagues who have vied with one another to do honour to his splendid achievements and epoch-marking services to science.



E. Ray Lankester

In 1882 he was selected by Lord Rosebery, then Secretary for Scotland, for the Professorship of Natural History in the University of Edinburgh ; but the alterations and restrictions which the governing body sought to impose upon the new occupant of the Chair were distasteful to him, and he resigned within a fortnight of the announcement of his appointment, and resumed his London professorship, where, though the emoluments were smaller, the opportunity for useful work and the teaching of science was greater.

In 1890 he was appointed Linacre Professor of Comparative Anatomy at Oxford. In 1892 the principal trustees appointed him Director of the British Museum (Natural History) and Keeper of Zoology, from which posts he was retired in 1907 at the age of sixty, the year in which he was President of the British Association. As the distinguished writer of his obituary notice in *The Times* (16th August, 1929) said, with full knowledge of the facts : " Although he was still in vigorous health and fully capable of discharging his duties successfully, the trustees took advantage of a Treasury regulation which had never been applied before in such a case, and compulsorily retired him." It was Ray Lankester who made the Central Hall of the Museum a frequently changing exhibition of objects of useful, popular and scientific interest, arranged with an equal regard to beauty and instruction, and calculated to arrest attention and to impress the casual visitor with the wonders of Nature and the importance of a knowledge—even elementary—of the salient facts of everyday biology. On his retirement he was created a K.C.B. and received a Civil List pension in addition to the official pension of £300 per annum, which was the maximum that could be granted to him under the Civil Service regulations.

It was then that he began to contribute to *The Daily Telegraph* the series of delightful articles " Science from an Easy Chair," which had a widespread and significant influence upon the diffusion and popularisation of scientific knowledge, and which only ceased upon the declaration of war in 1914. He continued to write these short studies, and, under various titles, published several volumes of them, the last being " Great Things and Small " (1923).

Of his contributions to scientific literature it would be impossible to write, in even the most selective manner, in this place. He was but a boy when he published his letter on Pteraspis (Geologist, 1862), and only twenty when he wrote his monograph upon the Cephalaspidæ (Palæontographical Society, 1868-70), which still holds its place as a classic upon the subject. It was in 1863 that he contributed his first note upon the Gregarinidæ (Q.J.M.S., vol. iii), a prelude to the researches upon Protozoology and Parasitology that must ever be connected with his name. He was only seventeen when he wrote his first paper on the anatomy of the earthworm (Q.J.M.S., vol. iv, 1864). He may almost be said to have given the world a condensed summary of his life's work in the masterly essays which he contributed to the *Encyclopædia Britannica*—Protozoa, Hydrozoa, Mollusca, Polyzoa and Vertebrata in the ninth edition, Arachnida and Arthropoda in the tenth and Zoology in the eleventh, whilst he is probably best known to zoologists all over the

world by his work upon *Limulus*—the king crab—(Q.J.M.S., 1881), in which he showed its affinities to the Arachnida (the scorpion)—he was above all a morphologist—and not to the Crustacea, and by his monograph upon the Okapi. It was in 1869 that he became co-editor, with his father, of the *Quarterly Journal of Microscopical Science*, and was sole editor from 1878 until 1920, when the labour involved became too heavy for his declining physical—but not mental—powers.

In his later years he plunged with his wonted enthusiasm into the study of flint implements, especially in support of J. Reid Moir's work upon the Pliocene implements from the Red Crag of Suffolk. In this connection I have always felt somewhat guilty, for, having sent him some very remarkably shaped flints from the foreshore at Selsey Bill, he immediately published a magnificently illustrated paper upon them in the *Proceedings of the Royal Society* (B, vol. 92, pp. 162-7, pls. 8-11). I implored him not to publish until he had visited the site with me and seen the mass of such flints that was then exposed upon the foreshore; but he "went ahead," and his articles on the subject at this time aroused a fierce controversy, in which Professor W. J. Sollas, F.R.S., was his leading antagonist, Sollas having satisfied himself, upon a visit to me, that these rostro-carinates were the result of natural flaking and not artefacts. But Lankester never receded from the position he had taken up, even after his next visit to me, when I showed him the vast collection of similarly flaked flints upon the shore. He nearly provided a fine instance of the *tegula cadens* on another occasion. He arrived at Selsey, to spend his seventieth birthday with us, full of an article he proposed to write upon a new genus of Foraminifera, which he proposed to call *Allantidium*, from its resemblance to a sausage. He had no type-specimens, but proposed to describe the genus from some drawings he had made from an organism dredged, in company with the Rev. A. M. Norman, off the coast of Norway many years before. I ventured to point out that his creature was clearly a species of the well-known genus *Gromia* (Dujardin, 1835). He "boomed" at me in his characteristic and delightful manner, but next morning before he appeared—he was a very late riser—I spread open on the table where he worked in my library all the figures of the genus available—and then fled from the wrath to come! When I returned at lunch-time, all the books were closed and arranged in a neat pile. I put them back on the shelves. Not a word was said, and we never heard of *Allantidium* again.

Splendid as he was in friendship, he was equally splendid as an enemy, persevering and withering where any sound principle was involved, but never unfair or remorseless. Whether he won or lost, he never bore malice. One remembers an occasion when he brought the whole force of his personality to bear in opposing the election of a candidate selected by the Council for the Fellowship of the Royal Society whom he considered unworthy of the honour. But when his opposition had failed (in spite of the support of some of the most influential Fellows of the Society), he accepted the *fait accompli*, and became intimately friendly with the man he had opposed. As Professor

S. J. Hickson, F.R.S., said in his tribute to Lankester in "*Nature*" (24th August, 1929), "he loved fighting, but was always ready to make friends when the fight was over, a readiness not always exhibited by the other side."

The irritability which grew upon him after he was retired from the Directorship of the Natural History Museum would sometimes have alienated the affection of his friends had he been a lesser man, but his subsequent apologies for his irritation had ever the result of cementing his friendships even more firmly than before. In 1926 it happened that I enlarged one of his "Easy Chair" articles on the myth of the barnacle and the goose (with full acknowledgment) into an after-dinner discourse before the "Sette of Odd Volumes," on which occasion he was present and spoke at some length on the subject after the paper had been read. He was, though I did not know it at the time, extremely angry with me, and a letter he wrote me, refusing the dedication of the portentous volume into which it was subsequently enlarged, startled me by its direct virulence. In reply to my remonstrance and expressions of regret he wrote at once: "My Dear Ned—I must ask you to forgive my bad temper. You see, I am in my 80th year, and am a very lonely old man, and naturally, and I think excusably, I get ill-tempered.* Rightly or wrongly, I was 'put out' by your taking up the Barnacle-Goose business, but of course this is a free country. And I ought to have remembered how many pleasant days in the past I owe to you, all the kindness you showed to me on many occasions at Large Acres, and the real help and sympathy you gave me in regard to flint implements and other matters, so please look on my 'ungenial' letter as a lapse—due to senile decay! I might have, and ought to have, said the same things but in another key, or, rather, to a kindly and pleasant tune instead of a sour and snappish one. I hope you will believe I am sorry for it, and that I do not really forget the many kind things you have done for me." I cannot forbear quoting this letter in full, for it shows most typically, and in his own words, how great, in every sense of the word, the man was, and, after all, his irritability was one of his most human and lovable traits. It sometimes produced comic situations. He had a horror of the people who lean across one in a railway carriage to look out of the window at stations. We were afflicted by such an one on an occasion when we were coming up from my country house. Ray grumbled at Chichester, expostulated at Arundel, exploded at Pulborough, and at Horsham "the spring snapped," and, opening the carriage door from the inside, he propelled the offender by a gargantuan "spank" on to the platform. His victim, after a few moments of dazed (but articulate) indignation, sent a porter for his impedimenta, and we saw him no more. Ray was quite "at the top of his form" on this occasion. But it was a fearsome experience to be his partner at any game in which the fortune of war went against him, to whichever of them blame might be attachable.

No one was ever more patiently helpful to beginners who sought to draw upon his seemingly inexhaustible store of knowledge, but anything in the nature of charlatanry or fraud roused him to active and very practical fury.

His exposure of the celebrated medium Slade in 1876 has passed into history, and to the day of his death he waged ruthless war upon the so-called "water-diviners" and other apostles of "occultism." He did not "suffer fools gladly." To him a sciolist, after a few moments of apparent puzzlement on his part—always a signal of deadly danger to those who knew him—became a pleasant plaything, and by the time the play was finished, one was reminded of an ass in a lion's skin vainly trying to elude the attentions of a gigantic mosquito.

His biographer in *The Times* obituary notice above quoted summed up this combative side of Ray Lankester's personality, a side which prevented his attainment of the greatest ambition of his life—the Presidency of the Royal Society—in the following words: "He had almost a genius for putting himself in the wrong by explosive and unconsidered action in a just cause, or at least in an otherwise completely tenable position. The mistake once committed, Lankester would concentrate his attention exclusively on the justice of his cause, while those who were opposed to him would see nothing but the violence of his conduct. His misunderstanding with the University of Edinburgh, his lawsuit with the University of Oxford, his brush with the police in Piccadilly, his relations with the standing committee of the Natural History Museum, and many minor events in his career, were variants of the same theme. His character, his intelligence, and a really high conscientiousness made it practically certain that in any dispute he would be on the side of real justice and wisdom; but if there were any way of proceeding impulsively and imprudently, he was more than likely to stumble into it."

He accepted the Presidency of the Royal Microscopical Society in the year 1909, but after attending the inaugural meeting he left the conduct of the meetings in the hands of his vice-presidents. I reproached him mildly for not attending the meetings, and he explained that it was a year of unexpected stress and strain upon him. His affairs had by no means righted themselves or recovered from the wholly unexpected shock of his retirement, and the consequent very serious loss of income, which had compelled him to abandon the charming house and garden he had established at Putney. In a word, he was sorely "put to it" to accommodate himself to the new and reduced conditions, and with his increased literary output, which had become a financial necessity, he was not up to the strain of conducting scientific meetings in the evening as they should be conducted, so he relied upon his vice-presidents to spare him this fatigue, whilst all the time, as he told me more than once, deeply touched and honoured to have been elected to the chair which his father had occupied exactly half a century previously. He said to me on one occasion: "Wait till *you* are President; then I promise I will come and attack you in your presidential chair."

And he did. He half supported and half differed from me in the crusade I had embarked upon to prove the phenomena of purpose and intelligence in the Foraminifera. He objected to anything that savoured of teleology,

and he considered (wrongly, as I considered) that some of my arguments were teleological, in the sense implied by Huxley (*Crayfish*, vol. ii, p. 47). He prepared a paper attacking the position I had taken up, and submitted it to the Council. This gave me the chance to study it and prepare a reply which I hoped might be crushing. This reply I sent to him, that he might be "precognosed," as the Scottish lawyers say. He then prepared a "rejoinder," which he submitted to me, and we subsequently had a crowded meeting which was attended by many notable zoologists, who took part in the discussion. It was great fun, and I hope—and believe—that our "rapier-like exchange of wit and argument" seemed to the audience to be brilliantly impromptu! His paper and my reply and the subsequent proceedings were published in full in our 1916 volume (pp. 133-40).

I have perhaps trespassed too long upon the space in our *Journal* and upon the patience of my readers. My main difficulty has been that of selection, for to do justice to his many-sided personality and wide activities would necessitate a notice many times the length of the present essay. I have, among other things, had to leave untouched his work as one of the founders and, until his death, President of the Marine Biological Laboratory at Plymouth; but I feel gratified and honoured to have been granted this opportunity of paying a humble tribute to one of the greatest scientists of his age, and one of my oldest and greatest friends.

ABSTRACTS AND REVIEWS.

ZOOLOGY.

(Under the direction of G. M. FINDLAY, M.D.)

HISTOLOGICAL TECHNIQUE AND STAINING.

Progress in Standardization of Stains—Safranin.—H. J. CONN (*Stain Technol.*, 1929, 4, 65–8). Various types of safranin have been placed on the market. There are quick- and slow-acting safranins, either of which may be used, for instance, in the Flemming triple stain, but with one the staining must be prolonged several hours; with the other it may be finished in a few minutes. The explanation of this different behaviour has not yet been found, as the dye itself in these two types seems to be the same, so far as can be recognised by tests known at the present time. In several batches of safranin, all prepared from the same lot of crude dye, some may be rapid in their action, others slow. This suggests that the difference between these two types of safranin is not in the dye itself, but in the impurities that may be present. No actual correlation, however, with either the ash content or hydrogen-ion concentration of the sample has yet been established.

G. M. F.

Influence of Impurities upon Dyes.—H. J. CONN (*Stain Technol.*, 1929, 4, 68–9). There are two ways in which impurities may come to be present in a dye. In the first place, a strictly pure dye is impossible because, in the course of manufacture, certain mineral salts are either formed or introduced, and cannot be completely eliminated by any method of purification. A dye content of 90 p.c. is about the best that can be hoped for in the case of any dye. In the second place, an impurity is often intentionally added to a dye so as to standardize its strength. The diluents most commonly employed are sodium chloride and dextrin. Whether or not these substances are actually inert has not yet been determined. An impurity may influence the action of a stain by changing its reaction, by altering the solubility of the dye, or by changing the rate at which the dyes are adsorbed by the tissues. Examples are the more intense staining of rose bengal in the presence of calcium salts and the addition of ammonium oxalate to crystal violet in the Gram stain.

G. M. F.

A Method for Staining Connective Tissue Mast Cells.—M. LEVINE (*J. Lab. & Clin. Med.*, 1928, 14, 172). The material is fixed in any of the usual fluids and embedded in paraffin. Material is sectioned 5 to 10 μ and passed down to water, stained in 1 to 2 p.c. thionin in water, and dehydrated. The sections are then stained in orange G in oil of cloves—xylol, Canada balsam. The cytoplasm stains faint orange; mast cells are stained deep blue or purple, and the difference between these and stroma nuclei is well marked by difference in intensity of staining, the latter staining faint blue.

G. M. F.

Microscopic Projections in the Measurements of Erythrocytes.—F. P. PARKER and G. T. LEWIS (*J. Lab. & Clin. Med.*, 1929, 14, 664). Details are given of a projection method for measuring erythrocytes which is accurate to 0.25μ . A 400-watt flood light with concave reflector and planoconvex lens three inches in diameter is used as a source of illumination. For magnification a monocular microscope with the condenser, mirror and draw tube removed is used. With a 1.8 mm. oil-immersion objective the magnification that may be secured with the apparatus is 500 diameters. G. M. F.

A Rapid Method for the Staining of Mucus by Toluidin Blue.—R. D. LILLIE ("Eine schnellmethode zur Toluidinblau-Schleimfärbung," *Ztschr. f. wiss. Mikr.*, 1928, 45, 381). Formol or sublimate may be used as a fixative. Frozen or paraffin sections are taken through alcohol to water, stained for a minute in 0.2 p.c. aqueous toluidin blue, washed quickly in water, then in pure acetone, xylol and balsam. Old formol material causes the formation of a fine precipitate, which can be removed by a short washing with 90 p.c. alcohol, followed by acetone and xylol. Mucus is stained red violet, cartilage blue violet, nuclei and bacteria deep blue; undecalcified bone is unstained with blue bone cells, light violet Sharpey fibres, and bright blue border lamellæ; decalcified bone is coloured bright blue, red blood cells yellow or greenish yellow, and other tissue green, blue green or blue, G. M. F.

The Influence of Temperature on the Staining of Blood Films.—G. W. OCHS ("Über den Einfluss der Temperatur auf die Färbung von Blutausschrich-Präparaten," *Folia Hæmatologica*, 1928, 37, 241–57). An increase in methylene blue staining and a decrease of eosin staining occur with increasing pH. Neutrophil granules stain best with methylene blue at pH 6.8. With increase in temperature an increase in eosin staining is obtained, the difference in adsorption being noticed more in the changing of the colour of the dye than by the change in intensity of the staining. With recognised exceptions there was also an increase in methylene blue staining with rising temperature. Results of experiments using Giemsa solution (Grübler) were like those obtained with methylene blue. G. M. F.

A New Specific Stain for Myelin.—J. VERNE ("Une nouvelle coloration élective de la myéline," *Bull. d'Histol. appl.*, 1928, 5, 223–4). Nerve trunks not thicker than 1 c.m. are fixed for from ten hours to not more than two days in one of the following fixatives: (1) A saturated aqueous solution of corrosive sublimate, 30 parts; physiological saline, 70 parts; (2) Platinic chloride 1 gm., distilled water 100 c.cm. If desired, the tissue may be preserved in a very dilute solution of the fixative used. The tissues are washed in running water and then cut into sections by the freezing method. The sections are placed in 90 p.c. alcohol for ten minutes to remove portions of myelin detached by the razor. Wash in water and then place in the fuchsin reagent prepared as follows: To 200 c.cm. of a 1 p.c. basic fuchsin are added 20 c.cm. of N/1 HCl and 1 gm. of dry sodium bisulphite. After 24 hours the solution is a yellow amber ready for use. When the regions rich in myelin become intensely coloured, rinse in the following solution: HCl, 10 c.cm.; liquid commercial sodium bisulphite, 10 c.cm.; water, 200 c.cm. The solution is changed several times. The sections are rinsed in water and mounted in "sirup d'Apathy." Myelin is coloured intense violet, grey matter and non-myelin region are uncoloured. G. M. F.

The Use of Mixtures of Fuchsin and Basic Blues in Histological Staining.—E. HOUCKE ("Emploi des mélanges de fuchsines et de bleus-basiques

pour la coloration basique," *Compt. rend. Soc. de biol.*, 1928, **99**, 786). Staining by the following method may be used with Zenker-formol fixation, Bouin and formol-alcohol, and is specially recommended for red blood corpuscles and acidophilic elements : (a) 1 p.c. aqueous acid fuchsin, 14 parts ; 1 p.c. methylene blue, 22 parts. The methylene blue solution is poured into the acid fuchsin solution in a glass and allowed to stand for 24 hours. Then the liquid is decanted off, the precipitate is dried and dissolved in 20 c.cm. of 99 p.c. methyl alcohol. (b) A saturated aqueous solution of thionin, 10 c.cm. ; 1 p.c. acid fuchsin, 20 drops. Centrifuge, decant, drain. Redissolve in 10 c.cm. of 99 p.c. methyl alcohol. (c) 1 p.c. aqueous solution of toluidin blue, 11 c.cm. ; 1 p.c. aqueous acid fuchsin, 5 c.cm. Treat as described for (b). To 10 c.cm. of distilled water add 10 drops each of a, b and c and 2-3 drops of acetic acid 1 in 100. Stain sections for 2 to 3 hours ; for formol fixed material 15 to 30 minutes may be sufficient. In general, when the erythrocytes are bright red, the staining is sufficient. Wash three times in absolute alcohol, xylol and mount in dammar. This general method may be used for any combination of an acid and basic dye. G. M. F.

Stain Solubilities. Part IV.—W. C. HOLMES (*Stain Technol.*, 1929, **4**, 73-4). Further solubility data on dyes are recorded. Salts of erythrosin are less soluble than the corresponding salts of eosin, but salts of phloxin are more rather than less soluble than those of eosin, while salts of rose bengal are more soluble rather than less soluble than those of erythrosin. When halogen radicals are substituted, both the nature of the substituent and the location of the substitution affect solubility. Solubility is decreased by substitution within the resorcinol residues of the dye, and is decreased more by iodine than by bromine. On the other hand, substitution in the phthalic anhydride residue increases solubility. G. M. F.

The Mechanism of Staining: the Case for the Physical Theories.—W. C. HOLMES (*Stain Technol.*, 1929, **4**, 75-80). The chemical theory of staining and dyeing is discussed, but is found wanting, and the theory of adsorption is upheld, it being concluded that the general character of bacterial staining is one of adsorption in which electrostatic affinity plays the principal rôle. G. M. F.

A Note on the Gram Stain.—A. ZEISSIG (*Stain Technol.*, 1929, **4**, 91-2). A modification of the Gram stain in which iodine alcohol is substituted for 95 p.c. alcohol as a decolourising agent has been found particularly useful in staining Gram-positive organisms in tissues and also for smears. The technique for tissue sections is as follows : (1) Apply nuclear stain ; (2) wash ; (3) stain in Hucker's gentian violet for 2 to 3 minutes (i.e. 1 part saturated alcoholic solution of crystal violet to 4 parts 1 p.c. aqueous solution of ammonium oxalate ; (4) wash in water ; (5) stain in Gram's iodine 5 minutes ; (6) wash in water ; (7) decolourise in 95 p.c. alcohol to which enough tincture of iodine has been added to give a mahogany colour ; (8) counterstain ; (9) dehydrate and mount. G. M. F.

Improvement in Technic and Results made in Examining Microscopically by the Razor Section Method 2,000 Malignant Tissues.—B. T. TERRY (*J. Lab. & Clin. Med.*, 1929, **41**, 579). Improvements in the original technique now make it possible to cut thin slices still thinner, to section very small bits of tissue, and to obtain good results with refractory tissues such as those containing large amounts of colloid or mucus, or tissues that are so soft that they make sectioning difficult. Fixation in hot formalin makes it possible to use the author's method on tissues of the above type. Staining with Harris' hæmatoxylin is recommended

in addition to the usual neutralised polychrome methylene blue staining. Diagnosis made by this method was found to check with diagnosis made by the pathologists of the Mayo Clinic using the frozen section method in 98 p.c. of the 2,000 cases.

G. M. F.

Nuclear Structures and Chromosomes in the Living and Fixed Cell.—

P. MARTENS ("Les structures nucléaires et chromosomiques dans la cellule vivante et dans la cellule fixée," *Bull. d'Hist. appl.*, 1928, 5, 229-52). Observations of the resting nucleus of the living cell made it apparent that the nucleus of this cell is made up of a reticular filamentous structure with granular embedding at the intersections of the network. A second method of studying the problem was the close observation of the cell during the process of fixation. Bouin and Benda's fluids were used, and the only result of fixation is that visibility of the existing structure is accentuated and no new structure is created by the process of fixation.

G. M. F.

Influence of the Decrease in Concentration of the Dyestuff on Vital Staining with Trypan Blue and Lithio-Carmine.—

W. N. KONSTANTINOW ("Über den Einfluss der Konzentrationsabnahme der Farbstoffe auf die Vitälfärbung mit Trypanblau und Lithioncarmin," *Ztschr. Ges. Exp. Med.*, 1927, 55, 655-71). Methods of vital staining depend upon the capacity of the cell to absorb the dye and deposit it in the protoplasm. All factors influencing the results are important from the standpoint of normal and pathological morphology and histophysiology. Various concentrations of trypan blue and lithio-carmine were injected intravenously into the ear of rabbits daily for 5, 10, or 20 days, after which the animals were killed and the tissues examined both macroscopically and microscopically. There were differences in behaviour of various tissues, but most tissues stained more deeply in higher concentrations. In general, vital staining was possible in weaker solutions of trypan blue than of lithio-carmine. As concentration of injected dyes decreased, the characteristic differences in ability of various types of cells to absorb the dyes became evident; bone and teeth stained more readily in lithio-carmine, whereas the aorta and its branches had a greater affinity for trypan blue.

G. M. F.

Petroleum and Petrol as Solvents in Paraffin Embedding.—

T. VASILIU ("Emploi du pétrole et de l'essence comme solvants dans l'inclusion à la paraffine," *Compt. rend. Soc. de biol.*, 1929, 100, 691). Petroleum or petrol may be used as the intermediary between absolute alcohol and paraffin. It is advisable to add 10 p.c. of xylol, benzol or toluol to either the petroleum or petrol.

G. M. F.

Definiteness in Staining Formulæ.—

H. J. CONN (*Stain Technol.*, 1919, 4, 33-5). In this paper a plea is made for the more accurate description of staining formulæ both in text-books and original papers. Formulæ such as "1 part alcoholic solution of fuchsin, 10 parts of water," are entirely valueless. In America, where there is now a Commission on the Standardization of Biological Stains, it is possible to define accurately each particular stain by stating the colour index, the number of the dye, the certification number of the sample, as well as the total dye content, all of which are furnished by the manufacturers on the labels of all certified stains. In less enlightened countries all that can be done is to quote the name of the dye, the name of the manufacturer, and any shade designation or qualifying information that is given on the label.

G. M. F.

The History of Staining : Logwood Dyes.—H. J. CONN (*Stain Technol.*, 4, 37-48). A detailed history of the use of hæmatoxylin as a dye, beginning with its employment by Waldeyer (1863). The paper contains an extensive bibliography.
G. M. F.

The Chemical Analysis of Thiazin Eosinates.—W. C. HOLMES (*Stain Technol.*, 4, 49-52). Blood stains such as Wright's and Leishman's are usually prepared by the alkaline oxidation of aqueous solutions of methylene blue, and the precipitation of the resulting mixture of the dye and its lower homologues by the addition of an aqueous solution of eosin. Normal thiazin eosinates should be formed, but a thiazin "bieosinate" might also be formed. There is therefore a possibility of wide variations in actual dye content. In order to standardize these stains, both chemical analyses and spectrophotometric examinations must be employed.
G. M. F.

A New Staining Dish for Handling Cover-Glass Preparations.—R. H. BOWEN (*Stain Technol.*, 1929, 4, 57-8). A dish has been designed for the simultaneous staining of four cover-slips. The interior of the dish contains grooves which permit of the treatment of cover-slips from $\frac{3}{4}$ to $\frac{7}{8}$ of a square inch.
G. M. F.

A Cytological Fixative adapted for Insect Tissues.—Y. NAN ("Sur un fixateur cytologique particulièrement adapté aux tissus des insectes," *Bull. d'Hist. appl.*, 1927, 4, 711). Tissues should be placed in the following fixative for from 3 to 7 days :—NaCl 0.9 p.c., 86 c.c.; formol, 14 c.c.; chromic acid 0.8 p.c., 20 c.c.; nitric acid, 4 drops. Embed in paraffin, section and stain with iron-hæmatoxylin.
G. M. F.

A New Embedding Method for Hard Objects.—H. REICHARDT and A. WETZEL ("Paraffineinbettungsmethode nach vorhergeganener Zelloidindurchtränkung unter Vermeidung der härtenden Intermedien, Xylol, Benzol, Chloroform," *Ztschr. f. wiss. Mikr.*, 1928, 45, 476-9). The method is a modification of the Peterfis technique for embedding hard or brittle objects, using methyl benzoate in place of benzol for cleaning the tissue. The tissue is first treated in the usual way with absolute alcohol and is then placed in methyl benzoate till it becomes infiltrated and sinks. Treatment with 1 p.c. celloidin in methyl benzoate follows, the tissue remaining in this for from two to five days according to size. The tissue is then transferred to methyl benzoate containing chips of paraffin; it remains here at 40° C. for from 12 to 24 hours. Finally the objects are placed in melted paraffin at 50° C. This is changed at least three times. Sections are cut with a knife that is not hollow ground.
G. M. F.

A New Fat Stain.—P. GALESESCO and S. BRATIANO ("Colorations des graisses par l'extrait alcoolique de *Daucus carota*," *Compt. rend. Soc. de biol.*, 1928, 99, 1460). An alcoholic extract of carotin, the yellow pigment of carrots, may be used in histology as a fat stain. The cortical zone of carrots is cut up into small pieces and immersed in 90 to 95 p.c. alcohol in a stoppered flask and put in a water bath for two hours and then stood in a dark place for 8 to 10 days. The solution is decanted and filtered. Before use the solution is diluted with distilled water until the alcohol is from 60-80 p.c. Frozen sections are cut from formol fixed tissue which has been washed in running water for 24 hours. The sections are first placed for 5 minutes in 50 to 70 p.c. alcohol, then for from 6 to 24 hours in the alcoholic solution of carotin. They are next rinsed in 50 to 70 p.c. alcohol, washed in water and stained with Boettner's hæmatoxylin, washed in water and mounted in glycerine jelly. Fats and lipoids are stained a golden yellow.
G. M. F.

Cytology.

A *Drosophila* Mosaic, probably due to Dispermic Fertilisation.—G. BONNIER (*J. Genetics*, 1928, 19, 257–60). A ♀ carrying in one X the gene B for bar eyes and in the other X the gene f^2 for forked⁵ bristles was crossed to a ♂ with the gene f^2 in his X. Among the progeny there was a ♂ mosaic which on abdomen, thorax and the right side of the head had normal bristles, but on the left side of the head had forked⁵ bristles. In addition to this his right eye was a bar one, whereas the left was a round one. This left eye was, however, smaller than normal, and with a margin free of facets. Different explanations are discussed, but the most probable seems to be that two spermatozoa have taken part in the fertilisation. The one containing a Y chromosome has fertilised the egg nucleus containing a B-carrying X. The other, with an X or a Y, has fertilised a polar body with an f^2 -carrying X. The former nucleus has given rise to the whole body except the left side of the head, and the latter nucleus has given rise to this left side only. It is noteworthy that, since the left round eye is smaller than normal, the B-gene, though not present in the left side of the head, exerts some influence on the marginal facets of the left eye. It seems probable that this influence is related to hormonal influences.

Biological Abstracts.

Histological Findings in Visceral Organs after High Temperatures.—W. WEIMANN ("Histologische Befunde an den inneren Organen nach Einwirkung hoher Temperaturen," *Virchow's Arch. Path. Anat. u. Physiol.*, 1927, 264, 1–10, 6 figs.). Histological specimens obtained very shortly after death by burning showed the capsule of the liver nearly intact and the tissue injured by the heat for only a short distance underneath. This exhibited strands of homogenous staining material with intervening spaces filled with liquid fat. Somewhat deeper the liver cells appeared separated by clefts from the capillaries. These cells appeared homogenous. Cells still deeper exhibited shrunken nuclei and a much vacuolated cytoplasm. The surface of the kidney presented a reticulum of homogenous coagulated tissue with liquid fat in the interspaces. The uriniferous tubules were enlarged and apparently bloated with gas. Fat was found in the larger blood vessels. Char covered the surface of the lung. The tissue beneath was homogenous with the absence of nuclei. The alveoli were filled with homogenous staining material. The outer layers of the skin were likewise a homogenous reticulum with liquid fat in the spaces. Fat was also found in the vacuoles of the cells of the sebaceous glands. Cell structures in the greater part of the skin were obliterated.

Biological Abstracts.

The Oxidation-Reduction Power of Mitochondria.—P. JOYET-LAVERGNE ("Sur le pouvoir oxydo-réducteur du chondriome," *Compt. rend. de l'Acad. des Sc.*, 1928, 186, 471–3). The demonstration of the existence of a lipid component in mitochondria led to the hypothesis that the chondriosome is the seat of the oxidation-reduction phenomena in the cell. Experiments with liver tissue of *Rana temporaria*, placed in 2 p.c. aqueous solutions of pyrogalllic acid, metol, hydroquinone, and diamidophenol, showed the chondriosomes to be coloured black, thus proving their oxidizing power. Paraphenylene diamine and metaquinone (1 p.c.) in 50 p.c. alcohol gave similar results. Cells of the intestinal epithelium of *Rana* were less favourable material. Hepatic cells of *Bufo vulgaris* gave results comparable but less constant. The oxidizing properties of the chondriosome were also demonstrated in plant cells. A 2 p.c. aqueous solution of metol revealed the chondriosomes in the epidermal cells of petals of horticultural varieties of *Amaryllis* and of *Crinum*

powelli to be analogous to those stained in Janus Green. In a 2 p.c. solution of metol small black grains and rods appeared in the cytoplasm of the pollen tube of germinating pollen grains of *Antirrhinum majus*. Pollen of *Capucine* treated with a 2 p.c. aqueous solution of pyrogallie acid gave similar results. In the liver cells and cells of the intestinal epithelium of *R. temporaria* the chondriosomes became black with gold chloride, showing that reduction of the reagent had occurred. A 1 p.c. aqueous solution of AgNO_3 was also reduced by the components of the chondriosomes, but the results were not so clear as with gold chloride.

Biological Abstracts.

The Pathology of the Bone Marrow in Pernicious Anæmia.—F. W. PEABODY (*Am. J. Path.*, 1927, 3, 179–202, 12 figs.). The technic of tibial puncture is given and summaries of seven cases are presented. Observations made on tissue obtained at biopsy, at different stages of the disease, show that myeloid hyperplasia is most marked during relapse, and structure of the marrow tends to return to normal during remission. During relapse the essential histologic lesion is a rapid and extensive proliferation of primitive cells (megaloblasts), with a relatively diminished tendency towards differentiation of mature cells of the erythrocyte series. Bone marrow shows a cellular hyperplasia, but it is functionally inefficient. Remissions are characterised by the presence of few megaloblasts and a great relative increase of normoblasts and mature red blood cells in the bone marrow. Anæmia of the relapse is explained by functional ineffectiveness of bone marrow, resulting from failure of megaloblasts to differentiate towards mature erythrocytes. The blood picture of remission is explained by resumption of a normal type of cell development with an increased production of normoblasts and erythrocytes. It is suggested that the striking clinical results obtained by feeding of large amounts of liver in production of prompt and marked remissions may be due to some factor in the liver which affects cell metabolism and promotes development and differentiation of mature red blood cells.

Biological Abstracts.

On the Chromosomes of the Domestic Mouse (*Mus wagneri albula*).—OSAMU MINOUCHI (*Jap. Jour. Zool.*, Tokyo, 1928, 1 (6), 269–73, 1 pl.). There are 40 telomitic chromosomes in spermatogonia, and 20 in first and second spermatocytes. In the first division a tetrad, composed of heteromorphic dyads, appears at the periphery of the equatorial plate. This is the heterochromosome of XY type. The ♂ is heterogametic and the ♀ homogametic.

Biological Abstracts.

On the Fixation of Chromosomes in Mammals and Some Other Animals.—OSAMU MINOUCHI (*Jap. Jour. Zool.*, Tokyo, 1928, 1 (6), 219–34, 1 pl.). Chrom-bichromate-osmic and chrom-osmic mixtures are recommended for fixation of chromosomes of such animals as mammals, reptiles and insects (Orthoptera). Strength of the mixtures should differ according to age and species of the animals. Glacial acetic acid is injurious for preservation of chromosomes. Chromosomes are well preserved at room temperature (15°–23° C.). To heat or to cool the fixatives is undesirable.

Biological Abstracts.

Spermatogenesis of the Albino Rat (*Mus norvegicus albus*).—OSAMU MINOUCHI (*Jap. Jour. Zool.*, Tokyo, 1928, 1 (6), 235–54, 2 pls.). There are 42 chromosomes (telomitic) in spermatogonia, and 21 in first and second spermatocytes. In the first spermatocyte metaphase appear 10 peripheral tetrads, one of which is composed of two heteromorphic dyads conjugating lineally a-b to a-b, and 11 V-shaped tetrads in the centre. The heteromorphic tetrads can be clearly traced back to the heterokaryosome in the growth period (the author classifies nucleoli in mammals

as plasmosomes, heterokaryosomes, and autokaryosomes). This is the heterochromosome of XY type, so that the ♂ is heterogametic and the ♀ homogametic. The spiral structure or chromonema appears in the chromosome, even in the heterokaryosome, of the growth period.

Biological Abstracts.

The Spermatogenesis of the Dog, with Special Reference to Meiosis.—OSAMU MINOUCHI (*Jap. Jour. Zool.*, Tokyo, 1928, 1 (6), 255–68). There are 78 chromosomes in spermatogonia, and 38 in first and second spermatocytes. The spermatogonium shows 77 telomitic and 1 atelomitic chromosomes, the oogonium 76 telomitic and 2 atelomitic. In the first spermatocyte metaphase a tetrad, composed of heteromorphic dyads, appears at the periphery of the equatorial plate. This can be traced back to the heterokaryosome in the growth period. A horizontal V-shaped chromosome is found at the equatorial plate of the second spermatocyte. From these facts it can be concluded that X is atelomitic and Y telomitic, the ♂ being of heterogametic and the ♀ homogametic. X and Y conjugate lineally, as seen in the heterochromosome of the albino rat.

Biological Abstracts.

Some Cytoplasmic Structures in the Male Germ Cells of *Gelastocoris oculatus* (Toad-Bug).—F. PAYNE (*J. Morph. & Physiol.*, 1927, 43, 299). The chondriosomes are first recognisable as two clusters in contact with the nuclear wall. Beneath each cluster lies a chromosome. This relationship is constant and indicates that these two chromosomes play a part in growth and development of the chondriosomes. The two masses fuse and the single mass grows considerably during the early growth period. Later it breaks up into a number of threads which become rings in the late growth period. The rings fuse into the large nebenkern which plays the usual rôle in formation of the tail. The Golgi material is first seen outside the chondriosomal cap. Early in the growth period it breaks up into Golgi bodies, which remain distributed in the cytoplasm during the growth period and spermatocyte divisions. About the mid-growth period a large number of spheres suddenly arise. Since they later fuse to form the idiosome, they are called the proidiosomal spheres. These spheres, which may originate in the Golgi bodies, remain scattered in the cytoplasm during the growth period and spermatocyte divisions. In the spermatid the Golgi bodies collect about the idiosome to form the acroblast. The Golgi remnants pass into the cytoplasm of the tail, while the acrosome elongates into a tail-like structure at the anterior end. The centriole was followed with unbroken continuity from the mid-growth period into the middle-piece of the sperm.

Biological Abstracts.

On the Existence of Two Chromosome Numbers in a Mixed Rat Strain.—O. SWEZY (*J. Exp. Zool.*, 1928, 51, 135–61, 2 pls., 6 text-figs.). A mixed colony of rats resulting from a cross between the Wistar strain of white rats and the wild grey rat, *Rattus norvegicus*, contains individuals some of which possess 42 and some 62 diploid chromosomes, both possessing 21 and 31 chromosomes in the secondary spermatocytes. The wild greys possess the same double numbers of chromosomes, but the Wistar rat only 42 diploid and 21 haploid. Rats of the colony mated with the Wistar rat produce offspring which possess only 42 diploid, but, in the case of ♂, both 21 and 31 haploid chromosomes. Evidence points to the fact that gametes with 21 and 31 chromosomes cannot mate. Rats with both 42 and 62 chromosomes appear in the same litter in matings made between members of the colony, regardless of the diploid chromosome count of the parents.

Biological Abstracts.

The Evolution of the Golgi Apparatus in the Egg Cells of Birds.—T. IKEDA ("Über die genetische Veränderung der Zellorganellen, besonders der

Golgischen in Vogeleizellen," *Folia. Anat. Jap.*, 1928, 6, 389-423, 9 pls.). The processes of evolution can be divided into five periods: (1) In the youngest oocytes of hens and ducks the Golgi apparatus is, in general, located in the more spacious side of the plasma girdle when the nucleus lies eccentrically. In binucleated ova the apparatus always lies between the two nuclei. In the pigeon's egg it is ring-shaped and surrounds the nucleus. (2) In the hen's egg it grows rapidly and forms a spherical mass of threads. Growth is much less in duck, turkey, and pigeon ova. (3) The thread, which forms the apparatus, breaks into pieces. (4) In hen's ova all pieces move toward the cell periphery. Most of them break into fine granules, which become attached to yolk corpuscles; the rest become arranged on the cell membrane. In ova of the duck, pigeon, and turkey the pieces break into fine granules, which are scattered in the cytoplasm. (5) In hen's ova the pieces at the cell periphery form masses of irregular shape, which again break up into fine granules and move toward the cell centre. In the duck and turkey, elements from the surrounding follicle cells penetrate the egg, where they undergo changes similar to those of the Golgi apparatus. The Golgi apparatus and mitochondria probably take part in yolk formation. The yolk nucleus and Golgi apparatus usually form in different parts of the cell in hen's ova. In ova of the duck the yolk nucleus appears very distinct, but the Golgi apparatus is very faint, so there is probably no genetic relation between them. Mitochondria first appear in ova as coarse granules surrounding the nucleus. Those near the Golgi apparatus move toward the periphery, where they break up into fine granules and disperse loosely on the forming yolk granules. Mitochondria in eggs of the duck and turkey come chiefly from follicle cells. As the yolk granules grow, the granules of mitochondria gradually disappear, as do those of the Golgi apparatus. *Biological Abstracts.*

Spermatogenesis of *Bruchus quadrimaculatus* (Coleoptera: Bruchidae).

—A. BRAUER (*J. Morph. & Physiol.*, 1928, 46, 217-31, 2 pls., 3 text-figs.). The spermatogonia undergo two mitotic divisions. After the second division the nuclei remain small and very dense for some time before the beginning of the growth phase. During this interval the nuclei do not assume again the characteristics of the interkinesis stages. In the primary spermatocytes typical tetrads are formed. The chromosomes are asymmetrical V-shaped. The end of one arm of the "V" fuses with the end of the corresponding arm of its synaptic mate. Disjunction takes place in the primary spermatocyte division. After division of the secondary spermatocytes, the chromosomes become vesicular and form a reticular nucleus in the spermatid, after which the chromatin becomes deposited as a chromatin rim around the nuclear periphery. The diploid number of chromosomes is 20 in ♀ somatic cells. An unpaired X chromosome is present in the spermatogonia, which fails to divide in the primary spermatocyte division, but passes as a whole to one pole in advance of the autosomes. The X chromosome divides normally in the secondary spermatocyte division with the autosomes. In the method of sex determination, *Bruchus* does not follow the method of the majority of beetles, since most of those studied adhere to the XY type. *Biological Abstracts.*

An Experimental Study of the Relation between Granules Stainable with Neutral Red and the Golgi Apparatus in Nerve Cells.—W. P. COVELL and G. H. SCOTT (*Anat. Rec.*, 1928, 38, 377-99). Smear preparations of ventral horn cells and of spinal ganglion cells of white mice and young rabbits, vitally stained with neutral red, were treated with osmic acid and with the silver impregnation methods for demonstration of the Golgi apparatus. Individual cells were observed throughout the various steps in the treatment. It was possible to follow

through the actual process of the osmication and silver impregnation of individual granules which had previously been stained with neutral red. The findings support the hypothesis advanced by Parat and his co-workers that the Golgi apparatus results from the treatment of neutral red stainable granules with silver and osmic acid.

Biological Abstracts.

The Physical State of Cellular Constituents.—L. LAPICQUE ("Sur l'état physique des constituants cellulaires," *Compt. rend. Soc. de biol.*, 1929, **101**, 623-7). In the undamaged cell not only is the cytoplasm quite clear, but the nucleus is entirely invisible. When the latter is seen, it is due to some injury to the cell.

G. M. F.

Free Oxygen and the Movements of Paramecium.—E. FAURÉ-FREMIET, C. LÉON, A. MAYER and L. PLANTEFOL ("L'oxygène libre et les mouvements des paramécies," *Compt. rend. Soc. de biol.*, 1929, **101**, 627-8). Paramecium can still exhibit movements in the absence of oxygen for as long as four days at a temperature of 0° C.

G. M. F.

The Endocrine Secretion of Invertebrate Animals.—G. KOLLER ("Die innere Sekretion bei wirbellosen Tieren," *Biol. Reviews*, 1929, **4**, 269-306). The presence of active sexual hormones can be assumed with a reasonable degree of certainty in cases where parasitic or experimental castration brings about specific changes in secondary sexual characters. One of the principal instances of this is in the parasitic castration of decapod crustacea by Rhizocephala, the result of which, in male crabs at least, is a definite approach to the female facies. It seems possible that the seat of formation of the hormones is not in immediate connection with the gonads themselves. Similarly, "stylopisation" in the hymenopteran *Andrena* causes alteration in the colour of the clypeus and differentiation of the tibia in both sexes, resulting in an unmistakable approach to the opposite sex. Earthworms, in which the testes are destroyed by parasites, lack the clitellum, a secondary sexual organ. In *Physcosoma* the existence of an endocrine gland necessary for the life of the animal has been demonstrated both histologically and physiologically. In Cephalopods the morphological characters of the branchial and pericardial glands suggest endocrine action. The fact that tyramine, a product of the salivary glands, has also been found in the blood is of particular significance. The œnocytes of larval and adult insects are unicellular endocrine glands. The secretory process originates in the nucleus of the œnocyte. By blood transfusion it has been shown that internal secretions are probably concerned in ecdysis and pupation of caterpillars, although the place of formation of the hormones is still unknown. Koller and Perkins have shown experimentally that the expansion and contraction of melanin in the chromatophores of shrimps and prawns is due to substances which are secreted in the blood of the animals in response to light stimuli. The seats of formation of the two endocrine secretions are situated respectively in the eyes and rostral region of the animals. These two substances do not lose their efficacy either by passing through the wall of the alimentary canal or by boiling, nor are they specific for species or genera. The feeding of invertebrate animals with vertebrate hormones has not yet led to definite and unambiguous conclusions.

G. M. F.

Cytology of Intracellular Calcium.—M. PRENANT ("Contributions à l'étude cytologique du calcaire," *Bull. biol. France et Belgique*, 1928, **62**, 21-50, 15 text-figs.). The author reviews the chemical and physical properties of vaterite, and describes the theory of its formation in vitro. Examples are cited of its

distribution in cestodes, molluscs and cyclostomes, with doubtful examples in various invertebrates. Origin and morphology of vaterite crystals are described in mantle cells of *Helix*, cells of *Berthella*, of *Archidosis*, and in connective tissue cells of cestodes. As interpreted by the author, the origin is associated with cytomorphosis. (1) The cells become filled with lipid droplets and multitudes of mitochondria. The nuclei enlarge. (2) The mitochondria break up into spheres, lose their staining reaction, and become hyaline. Gradually the whole cell appears hyaline. (3) This hyaline substance is considered as a complex substance containing CO_2 gas from which Ca is precipitated as the pH approaches alkalinity. The mitochondria play a direct part in production of the mineral, as granules or crystals appear in contact with these bodies. (4) The Ca, at first amorphous, is later precipitated as vaterite. The form of the crystal is determined in part by the shape of the mitochondrion with which it is associated.

Biological Abstracts.

Sexual Differences in Chromosomes.—K. OGUMA ("Studies on the Sauropsid Chromosomes. I. The Sexual Differences of Chromosomes in the Pigeon," *J. Coll. Agric. Hokkaido Imp. Univ.*, 1927, 16, 203–22, 2 pls.). A carefully developed technic demonstrates that the chromosome number is larger than previously reported, and that the ♀ is heterozygous, being of the XO type. The sex chromosome is V-shaped and is one of the largest chromosomes. No evidence of chromosome fragmentation was seen. Young embryos and testes were examined. Embryos showed 61 or 62 chromosomes; the testes 62. There was decided size variation, three large pairs being always at the periphery. There are four medium-large pairs, six medium, and the remainder small. Meiosis is typical, with the smaller chromosomes going to the poles first. All second spermatocytes contained 31 chromosomes.

Biological Abstracts.

Cytoplasmic Fusion in *Actinophrys sol*, with Special Reference to the Karyoplasmic Ratio.—J. B. LOOPER (*J. Exp. Zool.*, 1928, 50, 31–49, 2 pls.). The formation of temporary colonies, by fusion of individuals, is frequent under duress of capturing large objects of prey, such as rotifers or large protozoa. Formation of temporary colonies, by fusion, may be induced mechanically, and enucleated fragments can also be induced to fuse with other enucleated fragments or with nucleated individuals. Observations were made on enucleated fragments, fused aggregates of enucleated fragments, and on nucleated individuals in which the karyoplasmic ratio was altered, either by an increase or a decrease in cytosome. Individuals in which the cytosome was increased divided more rapidly than normal sister individuals. Increase in division rate was accompanied by corresponding increase in development of nuclear materials. Individuals in which the cytosome was decreased divided less rapidly than normal sister individuals. Enucleated fragments show no distinct individuality. Such fragments lose their identity in fusing with either a complete individual or with each other. Nucleated individuals retain their individuality in respect to size and endoplasm when fusing to form an aggregate or temporary colony. An organised nucleus is not necessary for temporary organisation, but is essential for permanent organisation. In fused nucleated individuals the endoplasmic masses are separated by an ectoplasmic sheath. This may be demonstrated by a 0.04 milliampere galvanic current.

Biological Abstracts.

On the Chromosomes of a Snake *Natrix tigrina*.—K. NAKAMURA (*Mem. Coll. Sc., Kyoto Imp. Univ.*, 1928, ser. B, 4, 1–18, 2 pls.). The spermatogonial chromosomes, fixed with a modification of Champy, are 40 in number, consisting of 5 pairs of V-shaped, 1 pair of long rod-like, 2 pairs of short rod-like, and

12 pairs of dot-like chromosomes. In the first maturation division each of 20 tetrads divides into 2 identical daughter dyads, which separate in the second division, and each spermatid receives 20 monads: 5 V-shaped, 1 rod-like, 2 oval and 12 dot-like. The 2 sex-chromosomes are easily recognised as 2 oval karyosomes, which unite to form a heart-shaped tetrad. The tetrad is reduced quantitatively by the first maturation division and qualitatively by the second. Between the 2 sex-chromosomes there is no perceptible differentiation in shape, size or staining capacity. Thus it is very likely that they are XX (or ZZ), and not XY (or ZW), and that the ♂ is homozygous for sex, the chromosome formula being $38 + XX$ (or ZZ).

Biological Abstracts.

The Falling Off of the Tendencies to Reproduce among Animals.—

E. DEVAUX ("La déchéance des aptitudes reproductrices chez les animaux," *Rev. scientifique*, 1928, **66**, 173-7, 1 text-fig.). The lower we descend in the animal scale the higher do we find their prolificity. A certain hypo-fecundity accompanies those animals whose sexual development is retarded. The largest individuals, the most evolved of each phylum, have been affected more than the rest in their reproductive faculties. The occurrence of large eggs, few in number, marks progress in evolution. As we proceed from reptiles to birds, still another phenomenon intervenes to limit fecundity. Since the right ovary and oviduct atrophy and disappear, birds are less prolific than reptiles; in return they acquire a more voluminous brain. This atrophy is pushed still further in ants, termites, and bees. In ants (since all neutrals are entirely castrated) the ♀ undergo complete atrophy of the ovaries. But for the "queens," which are prodigiously fertile, extinction would be total. They all die of hunger, void of intelligence, however, if the neutrals bring them nothing to eat. The cause of this is the excessive rationing of the nervous system followed by its arrest of development. On the contrary, the neutrals show surprising intelligence; their physiological castration has allowed the non-pathological suppression of a great rival for nutrition, and their cerebral ganglia are nourished to a superior degree. Among the higher vertebrates, other than man, the muscles and bones grow so quickly that they very early take such a preponderance as to become, in their turn, like the sexual tissue in the lower creatures, veritable captors of blood. In consequence they turn to their profit an important part of food destined for the brain.

Biological Abstracts.

The Effect of Prolongation of each Stage of the Life-cycle on crossing over in the Second and Third Chromosomes of *Drosophila melanogaster*.

—A. D. BERGNER (*J. Exp. Zool.*, 1928, **50**, 107-63, 11 figs.). In any one experiment only one stage in the life-cycle was studied. The duration of the larval stage was prolonged by low temperature or modified media; of the pupal stage, by low temperature. In the adult stage, ♀ were inhibited from laying through the use of alcohol or formalin fumes or modified media. The b pr region of the second chromosome and the D cu region of the third chromosome were used as markers, because they belong to sections particularly sensitive to environmental influence. The study of prolongation was restricted to its effect on the germ cells of F_1 ♀ (D/b pr cu). The percentage of crossing over for each two-day interval during the first 17 days of egg laying of treated and control ♀ was calculated, and from these data "age curves" were drawn. Prolonging the larval or pupal stages or inducing temporary sterility of adult ♀ causes an increase in the amount of crossing over. The duration of the effect was roughly proportional to the length of the prolongation, with some limiting factor which made the duration of the effect for more than eight days rare. This effect of prolongation is limited to eggs in the mid-oogonial stage. The

physiological age of the germ cells of treated ♀ had advanced beyond that of untreated ♀ at the time when egg laying began, but it was not wholly independent of that of the soma.

Biological Abstracts.

The Effects of Anterior and Posterior Selections on Fission Rate in Pure Lines of *Paramecium caudatum*.—C. F. DE GARIS (*J. Exp. Zool.*, 1928, 50, 1–14). Heritable diversities of fission rate in pure lines of *P. caudatum* were brought out by selecting (1) cells of anterior origin, (2) cells of posterior origin. Such selections were repeated as often as dividing cells were encountered. The resulting fission rates were usually higher in stocks of anterior selection; in one series, however, the rates were higher in stocks of posterior selection. The direction of change in fission rate was heritable (e.g., if a direction of increment was associated with an anterior stock, it remained so associated as long as the stock was studied). From the foregoing evidence it follows that fission rate, *per se*, cannot be regarded as a heritably fixed character. As a special case, there was one line comprising stocks in which anterior and posterior selections brought out no appreciable difference in fission rate. The fact that diversities of fission rate are associated with anterior and posterior progeny of a single cell is taken to exemplify one means by which physiologic diversities arise in the course of evolution.

Biological Abstracts.

The Chromosomes of the Guinea-Pig.—B. B. LEAGUE (*J. Morph. & Physiol.*, 1928, 46, 131–41). The spermatogenesis of five guinea-pigs was studied. The spermatogonial chromosome number is approximately 62 ± 2 . The primary spermatocyte number is approximately 31. The spermatogonial number in the early prophase is lower than it is in later stages. This condition is due to late fragmentation of the large chromosomes found in the earlier stage. A possible sex chromosome of the XY type may be identified. Its components segregate during the first maturation division.

Biological Abstracts.

Dark-Field Study of Cytoplasm *in vitro*.—S. MOSSA ("La struttura del citoplasma degli elementi viventi coltivati *in vitro* studiata alla osservazione in campo oscuro," *Arch. exp. Zellforsch.*, 1927, 4, 447–61). The ground substance of most cells appears empty, but chondrioms, mitochondria, and granular inclusions are visible, the degree of visibility related to their physical condition. Fat drops are best seen. The structure of neuroblasts and of neurites is evident; even the finest neurites invisible under ordinary illumination appear as glistening threads. The author thinks that in neurones a specific substance in gel form is present.

Biological Abstracts.

On the Relationship between the Formation of Bile and Glycogen in the Liver of Rabbit.—E. FORSGREN (*Skand. Arch. Physiol.*, 1928, 53, 137–51, 2 text-figs.). A special histochemical procedure, based upon the fact that the most important constituents of the bile (bile acids and bile pigments) can in the rabbit be precipitated by BaCl_2 , has yielded some information concerning the formation of bile. There is normally an antagonism in the liver-cells between bile and glycogen formation. When a liver-cell contains an abundance of bile constituents, glycogen occurs sparingly, and *vice versa*. Thus liver function is periodic, bile formation alternating with formation of glycogen. During the secretory phase in the activity of the liver there is a low glycogen content in spite of good supply and slight consumption of carbohydrates (in well-nourished animals at rest). The glycogen content of the liver is not merely determined by "supply and demand" of carbohydrates, but also by the liver's own activity. Bile formation usually begins

in the periphery of the liver-lobules, where it subsequently continues longest; glycogen, as formerly known, is first deposited in a central area of the lobules, where it is last to disappear.

Biological Abstracts.

Experimental Exhaustion and Nerve Cells.—T. H. BAST, F. SCHACT, and H. VANDERKAMP ("Studies in Experimental Exhaustion due to Lack of Sleep. III. Effect on the Nerve-Cells of the Spinal Cord," *Am. J. Physiol.*, 1927, **82**, 131–9, 1 pl.). Nerve cells of the spinal cord show certain histological changes due to extreme exhaustion from lack of sleep. Nuclear chromatin is decreased in amount, due to chromatolysis. There is diffuse granulation throughout the cytoplasm. Vacuolation of the cytoplasm is found in a zone midway between the cell wall and nucleus.

Biological Abstracts.

The Histogenesis of Myofibrils.—S. B. WOLBACH ("Centrioles and the Histogenesis of the Myofibril in Tumours of Striated-Muscle Origin," *Anat. Rec.*, 1928, **37**, 255–73, 6 pls.). A study of cytological details accompanying the differentiation of cells in growing tumours of striated muscle, one from the heart and one from skeletal muscle. In both tumours there were cells in mitosis, cells with completely differentiated myofibrils, and cells in intermediate stages of development. The assumption is made that the tumour cells in their differentiation have recapitulated normal embryological sequences. Arrangement of cells of these tumours in order of increasing complexity of detail suggest the following sequence: multiplication of centrioles; dispersion of centrioles in the cytoplasm; formation of fibrils from the cytoplasm between the granules of centriole origin. The fibrillary material of cytoplasmic origin contracts to form the Z band (telophragma), the granules of centriole origin give rise to the dark disc or Q band.

Biological Abstracts.

Effects of Inanition on the Stomach and Intestines of Albino Rats underfed from Birth for Various Periods.—S. MILLER (*Arch. Path. Lab. Med.*, 1927, **3**, 26–41, 13 text-figs.). In albino rats severely underfed from birth for various periods (to 43 days), weights of the empty stomach and intestine were much greater than in normal (younger) rats of similar body weight. Increase in stomach weight appeared relatively much greater than that of the intestine. In comparison with younger controls of similar body weight, there also appeared in the test rats a marked absolute increase in thickness of the gastric tunica mucosa, in part accounting for increase in gastric weight. There was, however, a decrease in thickness of the tunica muscularis. Histologic preparations showed a variable amount of edema in the lamina propria of the gastric mucosa in the test rats, more severe in the rats underfed for the longer periods of time. This might in part account for increased gastric weight. Stomachs with most marked edema showed the greatest apparent increase in weight. In spite of increased weight and thickness, the gastric mucosa in test rats showed regressive structural changes to a variable extent, including atrophy and degeneration in restricted areas of the surface epithelium. The cells showed nuclear degeneration and cytoplasmic changes, with vacuolisation and loss of secretory granules. In extreme inanition the tunica mucosa became almost completely necrotic in some instances. Distinct changes from normal structure were not apparent in the gastric tela submucosa, except for occasional hæmorrhages from submucosal vessels. The gastric tunica muscularis in test rats showed a variable degree of atrophy and degeneration in muscle cells, not involving the whole thickness of the tunica, but occurring in restricted regions. In some places muscle cells completely disappeared and were replaced by fibrous connective tissue. In the small intestine of test rats the villi appeared variably atrophic and in extreme cases were completely disintegrated. The glands of

Lieberkühn likewise appeared atrophic and decreased in size, with degenerative nuclear and cytoplasmic changes. The lamina propria in the small intestine of test rats showed edema, which doubtless, as in the stomach, was a factor in causing increase in weight. The tunica muscularis of the small intestine in test rats did not present such marked atrophy of muscle cells as that appearing in the stomach. The large intestine in test rats showed changes in general similar to those observed in the stomach, but definite atrophy in muscle cells in the tunica muscularis was not observed. The histologic changes observed in test rats during the present chronic underfeeding experiments resembled more or less those described by other investigators in the alimentary tract of various animals subjected to different types of total or partial inanition. They also somewhat resembled those described for atrophic infants, but appeared in general more pronounced and less variable.

G. M. F.

The Gastric Glands in Avitaminosis.—F. GUARINO ("Ricerche sulle avitaminosi. Nota IV. Le ghiandole gastriche nelle avitaminosi," *Lo Sperimentale*, 1927, **81**, 15–29). In vitamin B or C deficiency the mucosa of the gastric glands in pigeons and guinea-pigs showed congestion and hæmorrhage, with a loss in volume of cellular elements. Epithelium showed progressive stages of degeneration, with ultimate desquamation of cells, disappearance of lumina, and disintegration of tubules.

G. M. F.

Maturation Phases in Human Oocytes.—L. HOADLEY and D. SIMMONS (*Am. J. Anat.*, 1928, **1**, 497–509, 2 pls.). Examination of oocytes of the first and second meiotic division, found in a well-preserved human ovary, favours the conclusion that the chromosomal number (somatic) of man is 48 rather than 24.

Biological Abstracts.

Mollusca.

Influence of a Changed Environment in the Formation of New Species and Varieties.—F. C. BAKER (*Ecology*, 1928, **9**, 271–83, 5 figs.). When artificially changed from a rapidly flowing river to comparatively quiet lakes, whorls of shells became more widely coiled, leaving an umbilicus in varieties previously having a closed umbilicus. In the clams (*Anodonta*, *Lampsilis*) there were a relative shortening and widening of the shells. The genera *Amnicola*, *Stagnicola*, and *Helisoma* were involved. Much of the fauna could not accommodate itself to the change, and migrated upward into parts of the river not affected by the rise of water, or remained below the artificial dam. The experiment was made possible by the building of a dam in the Chetek River, Wisconsin, about sixty years ago. Checks were made with varieties both above and below the lake area. Similar changes occurring in Lake Decatur, Illinois, an artificial lake recently formed, are also mentioned.

Biological Abstracts.

The Pectinidæ of the Swabian Jurassic.—K. STAESCHE ("Die Pectiniden des schwäbischen Jura," *Geol. u. Paläont. Abhandl.*, 1926, **15**, 3, 6 pls., 12 text-figs.). Whereas the Pectinidæ of the Tertiary, where this family is amply developed, are well monographed, the Mesozoic members of this group are not yet sufficiently worked out. The neglect of the Mesozoic Pectinidæ, and the Mesozoic bivalves as a whole, is due to the importance as guide fossils of the ammonites. Although less numerous than the Tertiary, the Mesozoic Pectinidæ are interesting, for this group at all times contains the most varied types. In its evolution, repetition and convergence play an important part and connect apparently heterogenous forms. The first part of the paper analyses the structure and biology as well as the evolution

of the recent forms as a basis for the study of the fossil species. The *Vola* problem is treated, and the preservation and geological occurrence of the family discussed. The Swabian forms are worked out and figured, and their connections and evolution are studied. It appears remarkable that Jurassic species of *Vola*, which occur only in the Lias of South America, are entirely absent from Swabia, as are also species of typical *Hinnites*. The genus *Amusium* first appears in the Tertiary. As a summary there is a short discussion on the origin and evolution of the Pectinidæ during Jurassic times. New species described: *Aequipecten reutlingensis*, *Camptonectes psilonoti*, *C. sowerbyi*, *Variamussium quinquenarium*.

Biological Abstracts.

Pseudohyaline American Land Snails.—H. B. BAKER (*Proc. Acad. N.S., Phila.*, 1929, 81, 251–66, 3 pls.). This paper is a continuation of one already reviewed in our last volume (*J. Roy. Micr. Soc.*, 48, 321), and contains data to show that *Pseudohyalina* “had become quite naturally a dumping ground for small land snails of dubious affinities. Practically all of the species treated here have at some time been grouped with *Pseudovitrea minuscula*.” *Microphysa* (*Zonitoides*) *cookei* has a radula and jaw indicating that it is a member of the *Endodontidæ* or *Sagdidæ*. Baker suggests that *cookei* is identical with the Vancouver species *M. ingersolli*. *Miradiscops opal* (Pilsbry) is referred to *Systrophidæ*, but the radula appears analogous in differentiation to that of *Pseudosubulina* and *Streptaxis*. It is noted that the eggs in typical specimens were very large, though no measurements are given. *M. puncticipitis* (Pilsbry) has a similar radula, but the absence of the central tooth is noted. *Zonitoides nitidus* (Müller).—Baker accepts H. Watson’s correction of his former description of the penial branch of the spermathecal duct with some reservation. It is necessary to study these details in both sex-phases. *Z. arboreus* (Say).—An explanation is offered of the former description of this species also. *Z. hoffmanni* (von Martens).—The radula figured closely resembles that of *Z. arboreus*. (We think it is possible to overestimate the importance of the presence or absence of external serrations on the external unci: both conditions are found in the genus *Vitrina*.) *Pseudohyalus* (N. gen.) *lateumbilicatus* (Pilsbry).—Baker has dissected a co-type of this species, and has thereby been able to give a valuable description. He says that this new section is created to fill the vacuum left after his sequestration of *Pseudohyalina* from *Zonitoides*. *P. limatulus* also has a dart and sac, according to Binney. The genus *Ventridens* (W. G. Binney and Bland, 1869) is used here as a sub-genus of *Zonitoides*, to include all of the species usually placed in *Gastrodonta* (Albers, 1850) except *G. interna* (Say), of which the internal armature of the peristome is fundamentally different, and accompanied by anatomical peculiarities which will require a re-definition of the *Gastrodontinæ* in order to include it in the nominally typical genus. The anatomy of four species of *Ventridens* (*intertextus*, *ligerus*, *suppressus* and *gularis*) has been discussed by Leidy (1851): that of *Z. acerrus* (Lewis) is fundamentally similar, though this species and probably all the others have an orifice which connects the lumen of the vergic sac with the capsular expansion of the peniospermathecal duct as in *Z. arboreus* (v. supra). *Z. ellioti* (Redfield, 1856) is here described anatomically and in detail. Interesting observations are added which appear to point to the possibility of self-impregnation. The shell of this species suggests that it belongs to the *Ventridens* group. *Pilsbryna aurea* Baker is described from a paratype about the size of the holotype shell; unfortunately the genitalia were still immature. *Pseudovitrea minuscula minuscula* (Binney).—The probable type specimens are described. They belong to the small northern race with about four whorls and obscure spirals. Measurements are given of these shells and of other specimens referred to the same

species but of varying local races. There are added notes on *Helicodiscus singleyanus* and *nummus* and *Chanomphalus pilsbryi* (*Endodontidae*). E. W. B.

Queensland Molluscan Notes.—T. IREDALE (*Mem. Queensland Mus.*, 1929, 9, 261–95). A large number of additions to the Queensland list, with many new species, new names, and critical notes. E. W. B.

Arthropoda.

Legs and Leg-Bearing Segments of Arthropods.—H. E. EWING ("The Legs and Leg-Bearing Segments of Some Primitive Arthropod Groups, with Notes on Leg-Segmentation in the Arachnida," *Smithsonian Misc. Coll.*, 1928, 80, 1–41, 12 pls.). A comparative study is made of the body segmentation and leg segmentation of a number of primitive arthropods in an attempt to homologise both the body sclerites and the leg segments. The leg musculature has been worked out in order to determine true from false segments. In the case of small specimens where dissections could not be made, special treatment was resorted to in order to reveal better the muscle attachments. Stained specimens, some of them being sectioned, were studied in order to define sclerites and muscle tendons. Results of the investigations indicate the following: (1) The generalised arachnid leg possesses one more segment than the maximum number of eight allowed by Hansen for the Crustacea. (2) The generalised pauropod leg is composed of eight rings, only six, however, representing true segments. The last four of these true segments are the femur, tibia, tarsus and pretarsus (claws). (3) The generalised symphylid leg is composed of seven true segments: A subcoxa in the form of a condyle-bearing plate, the coxa, a greatly enlarged trochanter, a much reduced femur, a tibia, tarsus and pretarsus (claws). (4) The generalised thysanurian leg is completely homologous with the pauropod type, with the exception that the first possesses a subcoxa. (5) The typical collembolan leg has a subcoxal segment, but either lacks the tarsus or possesses only a rudiment of this segment at the base of the claws. (6) The so-called coxal appendages of Pauropoda, Symphyla and Thysanura should not be considered as true appendages, as has been done by some investigators, since they have no muscle fibres attached to them. They are probably not homologous among themselves. Some may represent structures analogous, or possibly homologous, to the epipods of Crustacea. (7) The primitive insectan tarsus was three-clawed. Two-clawed or one-clawed tarsi found in certain thysanurans, or spring tails, are clearly not primitive, but are derived from the three-clawed type as found to-day in Pauropoda, Symphyla and certain Thysanura. (8) An additional segment, the cervical, should probably be recognised in the insect thorax. If so, it should be considered homologous with the legless, postcephalic segment of Pauropoda and certain symphylids. (9) The so-called intersegmental regions of the thorax of certain thysanurans should each be regarded as an integral part of the segment bearing the adjoining sternite posteriorly. (10) Primitive tergal plates were simple structures without condyles or apodemes, and did not completely cover the dorsal surface of the segments on which they were situated. (11) The primitive thoracic sternites of an insect were probably divided transversely into two sternal plates, the posterior of which articulated laterally with the inner condyles of the coxæ. (12) All vestiges of pleural plates are wanting in those arthropods investigated which had a cylindrical and functional subcoxa. (13) The theory that the pleural plates of insects originated from the subcoxal segments of the legs of insect ancestors is further confirmed.

Biological Abstracts.

Crustacea.

The Benthic Fauna of Japanese Lakes.—V. BREHM ("Ueber die Tiefenfauna japanischer Seen," *Arch. Hydrobiol.*, 1927, 18, 135, 27 figs.). The copepods and ostracods in the author's material from the depths of Lake Oakiko are discussed. There are descriptions of the first known harpacticids from Japan, the new species, *Canthocamptus nakaii*, *C. japonicus* ♀, *C. calvus* ♀, and notes upon two unnamed species of ostracods of the genus *Candona* designated as "Nr. 1" ♀ and "Nr. 2" ♀, and a third tentatively considered to be *Cytheridea lacustris*. The occurrence of the latter in Japan and not in America is explicable on the ground that the separation of Japan from east Asia antedates that of Alaska. The author remarks upon the probable systematic and zoogeographic relations of *Canthocamptus nakaii*, the only species in the collection represented by both ♂ and ♀. Unexpectedly, in view of what is known of the distribution of Japanese *Diaptomus*, no near relative is to be found on the neighbouring continent. The South American *Chappuisiella fuhrmanni* Brehm, of which the ♂ is unknown, is apparently the nearest. If the author's point of view is well taken, that *Canthocamptus nakaii* is phylogenetically related to South American species, then it could well be considered as belonging to a species-group distinguished by its peculiar distribution. In the sense of the "pendulum theory," it can be considered to have originated in the European quadrant and thence spread out toward the "western and eastern poles." In the bottom samples were found two planktonic forms, ♀ *Bosminopsis* carrying young, noteworthy because of the spiny armature of the margin of the carapace, a character which in this genus has been found hitherto only in the juvenile stages.

Biological Abstracts.

The Crustacean from which the name Cameroon is Derived.—T. MONOD ("Sur le crustacé auquel le Cameroun doit son nom (*Callianassa turnerana* White)," *Bull. Mus. Nation. d'Hist. nat., Paris*, 1927, 1, 80). The estuary known to-day as the mouth of the Cameroon was formerly called by the Portuguese navigators Shrimp River (Rio dos Camarões). This name was later changed to Cameroon. The original name was not an allusion to the Palæmonidæ or true shrimps, which are very common along the entire coast of West Africa, but to a thalassinid, *Callianassa turnerana* White, found only here, the history of which is remarkable. At intervals of almost exactly three years there occurs a periodic swarming of these animals, which come in huge numbers to the surface of the water. The natives are very fond of these crustaceans, which they call "mbeatoe," and the time of their swarming, which lasts three to six days, is the occasion of intensive fishing accompanied by religious festivals. Only the ♀ are an esteemed delicacy; the ♂, which cause a special irritation of the pharynx when swallowed, are used exclusively in the preparation of an oil, which, however, does not keep well. These crustacea come at a time when the waters of the estuary are only slightly salty. Both a horizontal and vertical migration take place, perhaps having some relation to sexual maturity, but the exact casual factors are still unknown.

Biological Abstracts.

The Cycle of Carotinoid Pigment in *Idya furcata*.—A. LWOFF ("Le cycle du pigment carotinoïde chez *Idya furcata* Baird (Copépode harpacticide)," *Bull. biol. France et Belgique*, 1927, 61, 193, 18 figs.). In the copepod the pigment layer of the eye is composed of flattened cells containing a layer of minute bodies of red carotinoid pigment, and in the middle a pavement of cubes of blue carotinoid-protein. The eyes of the larvæ are red. There are carotinoids in the lipoids in the blood and a

carotinoid-protein in the yolk. When fed on a bacterial culture free from carotinoids, the red colour is absent from the eyes, but the blue is present, and is therefore developed synthetically in the copepod. The presence of carotinoid pigments in the eyes seems to be general in the crustacea. The carotinoids in invertebrates play the same rôle as erythrosine in vertebrates. *Biological Abstracts.*

Male Reproductive Organs of Cyclopids.—G. HEBERER ("Zur Kenntnis der männlichen Generationsorgane der Cyclopiden," *Zool. Anz. Supplementband*, 1926, 2, 141, 3 figs.). The testis is located in the region of the first thoracic segment; it is variable in shape, and the variability seems to be greater in forms with many chromosomes than in those with few. Paired vasa deferentia originate at the anterior end of the gonad; each tube bends sharply backwards and continues as the vas deferens recurrens superior to the end of the third thoracic segment or into the fourth. Then it turns forward (vas deferens procurrens superior), and at the level of the testis it bends sharply ventrad (vas deferens descendens), to continue along the ventral side of the body (vas deferens recurrens inferior) to the genital pore. There are two secretory regions in the procurrens, and the descendens and the recurrens and inferior form a third. This third region suddenly widens in older animals, the epithelium is flattened in the wider part, and there is a differentiation of the contents into an enveloping and an internal secretory mass; the latter contains numbers of spermatozoa. A fourth secretory region is found in the part of the duct that lies in the genital segment. The contents of the spermatophore consist of four kinds of material corresponding to the four secretory parts of the vas deferens, and a cross-section of the recurrens inferior shows essentially the same arrangement of materials as in the spermatophore. The chemistry and the functions of the various secretions are more or less problematical. *Biological Abstracts.*

Degeneration of the Eyes in Cymothoidae.—B. EGGERT ("Beitrag zur Rückbildung der Augen bei der Isopoden-Familie Cymothoa," *Zool. Anz.*, 1927, 73, 33). Studies based on an isopod (*Cymothoa* sp. ?) parasitic in the mouth of a fish from the coast of Java. Judged from the organisation of the eye, during a definite period of its life-cycle it possesses fully-developed sight. Not only are the young at the time of leaving the maternal brood pouch able to perceive differences in light intensity, but the structure of the ocular elements would seem to indicate that they have visual perception as well. The layer of chitin over the eye is relatively thin and unpigmented, and would offer no hindrance to image formation. In specimens in which the brood pouch is formed there was observed more or less reduction of the eyes, no doubt determined by the mode of life of the cymothoids. Observations are lacking regarding the interval between their ecto-parasitic life and later life in the mouth of their host, when the eye is no doubt no longer functional. It appears, therefore, that the reduction of the ocular elements goes on progressively with the increasing age of the animal. To what extent the inception of this retrograde development and its course are influenced by purely physiological factors, and to what extent these processes can be inhibited or promoted by changes in its environment, can be determined only experimentally. *Biological Abstracts.*

Daphnia cucullata from Lake Nemi.—L. V. D'ANCONA ("Ulteriori osservazioni sulla *Daphnia cucullata* del Lago di Nemi," *Internat. Rev. Ges. Hydrob. u. Hydrograph.*, 1927, 18, 261). In 1914 Woltereck introduced *Daphnia cucullata* from Frederiksborg Lake (Hilleröd, Denmark) into Lake Nemi (Rome). This species, not naturally found south of the Alps, acclimated itself in this central Italian lake

and was recovered in 1922, 1924-26. In this new environment, in which is found an indigenous pelagic form, *D. longispina*, the northern species showed a fluctuating abundance, and was scarce or wanting in 1923-24. *D. cucullata* in Lake Nemi shows its greatest variability in the autumn, its least in winter and spring, increasing during the summer. The seasonal variation does not follow the temperature directly, being greatest in autumn with low temperature and least in spring with high temperature. There is a notable increase in variation in May. The rate of seasonal variation in *cucullata* is similar to that in the indigenous *longispina*. Compared with the original form from Frederiksborg, the acclimated form shows a greater total length, an equal maximum length of head, but not as low a minimum. The minimum width is the same, but the maximum is less. The stature of *neonate* and *primipare* is equal to that of the northern form, and thus also the growth in the first stages. The seasonal curve of variation is different, that of Lake Nemi having the maximum shifted toward the autumn. Here *D. cucullata* always has a sexual period in the autumn, which it has preserved from its original habitat and which is lacking in the indigenous *longispina*. In 1925, however, another sexual period of short duration, limited to a part of the population, was observed in the spring at the same time as the sexual period of the indigenous species. Regarded as an acquisition in the new environment, similar to the shift of the curve of seasonal variation, it may be concluded that the seasonal variation and also the sexual cycle respond in part to the external environment, and in part reveal the influence of hereditary factors. The two pelagic Daphniæ of Lake Nemi are always distinguishable morphologically as well as by their biologic behaviour.

Biological Abstracts.

Myriopoda.

Ventilation in Tracheæ of Chilopoda and Blood Circulation in Scutigera.—M. DUBUISSON ("Recherches sur la ventilation trachéenne chez les Chilopodes et sur la circulation sanguine chez les Scutigères," *Arch. Zool. exp. et gen. Notes et Rev.*, 1928, 67, 49, 10 figs.). From a histological study of *S. coleoptrata* it is apparent that the mechanism of breathing and blood circulation is similar to that of spiders and scorpions, since as in the Arachnida the blood must traverse the interlamellar spaces before returning to the heart. In *Scutigera* the lungs are dorsal, situated in the pericardial cavity, where aspiration due to systole is strongest. In Arachnida they are bathed by blood in the ventro-lateral lacunæ, which are connected with the pericardial cavity by pulmonary veins. Respiration and circulation are thus perhaps as highly developed as in the Arachnida. The second portion of the paper deals with effects of movement on respiration. This was carried out with a binocular. During immobility diffusion is sufficient for respiratory changes in the Chilopoda. Movements in Myriopoda cause deformations of the body which result in opening the spiracles, thus constituting the principal agent of tracheal ventilation. In *Geophilus* a peculiar type of ventilation is due to movements of the heart. The larvæ of Pterygote insects and the Chilopoda (except *Scutigera*) are thus equally advanced in tracheary ventilation. In Apterygotes (*Machilis*, *Sminthurus*, *Actaetes*, *Japyx*), which do not possess apparatus for closing the spiracles, the method of breathing is intermediate between that of Chilopods (and Pterygote larvæ) and that of Pterygote insects.

Biological Abstracts.

Arachnida.

South African Pseudoscorpions.—J. HEWITT and R. GODFREY ("South African Pseudoscorpions of the genus *Chelifer* Geoffroy," *Annals of the Natal Mus.*, 1929, 6, pt. 2, 305-36, 2 pls., 7 text-figs.). The authors give an account of the

genus *Chelifer*, which is followed by descriptions of the South African species of *Chelifer*, including *Chelifer cancroides* Linnæus, *C. walliskewi* Ellingsen, *C. musronatus* Tullgren, *C. minusculoides* Ellingsen, *C. minusculus* Ellingsen, *C. protractus* n. sp., *C. capensis* n. sp., *C. torulosus* Tullgren, *C. torulosus facetus* Tullgren, *C. sculpturatus* Lewis, *C. fulleri* n. sp. M. E. M.

The Indian Ixodidæ.—M. SHARIF ("A Revision of the Indian *Ixodidæ*, with Special Reference to the Collection in the Indian Museum," *Records of Ind. Mus.*, 1928, 30, pt. 3, 217-344, 2 pls., 49 text-figs.). The importance of ticks as disease carriers in man and domesticated animals has made their study very popular with parasitologists in other countries, but in India they have, so far, not received the attention they deserve. The tick fauna of India is very rich in the number of both genera and species, but most of the Indian species are poorly described and insufficiently illustrated. Until now the only up-to-date account of ticks is that of Nuttall, Warburton, Robinson and Cooper (1908-1926); but their work is still incomplete, and the descriptions of many of the Indian forms are far from adequate. In the present paper the author has attempted to amplify the descriptions of the Indian species that have been dealt with by the authors mentioned above, and he has redescribed other forms which occur in India, but have not before been dealt with. Some of the rarer Indian species described or recorded by previous workers, which there has been no opportunity of examining, are not considered in detail, but are only included in the analytical keys of the species. Most of the collections dealt with in this paper belong to the Zoological Survey of India (Indian Museum), Calcutta. An account is given of the technique and methods used in the study of the material, the terminology employed is discussed, attention is paid to the capitulum and its modifications in different genera for adequate fixation in accordance with their parasitic habit, and a summary of previous work on the Indian *Ixodidæ*, with a synoptic key to the Indian genera, is provided. The remainder, and major part, of this work is devoted to the full description of the species with which the author is concerned. M. E. M.

Insecta.

Control of the Japanese Beetle.—L. B. SMITH ("The Japanese Beetle—Present Status and Control," *Year Book Acad. Nat. Sciences of Philadelphia*, 1928, 5-15, 3 pls.). The Japanese beetle, introduced into the United States some time prior to 1916, found favourable conditions for its rapid multiplication. Since it attacked most of the economic crops grown in the North-Eastern United States, it presented a serious problem to American agriculturalists. As a result of research, methods have been developed for the protection of most economic plants through the introduction of foreign parasites and by the increase of other factors of natural control, and it is evident that numerical increase of the species has been permanently checked in the district occupied for the longest time by the Japanese beetle. Each year is bringing forth improved and more economical methods of plant protection, and the outlook for the ultimate control of this insect is stated to be most hopeful as far as natural agencies are concerned. M. E. M.

Biological Races of Ermine Moths.—W. H. THORPE ("Biological Races in *Hyponomeuta padella* L.," *Journ. Linn. Soc. (Zoology)*, 1929, 36, no. 249, 621-34). Experiments on the small Ermine moths of apple and hawthorn were begun three years ago with the object of investigating the remarkable variations in colour and life-history occurring in this species. The work is of necessity slow, owing to the

fact that the species is univoltine, but suggestive results have already been obtained with regard to certain aspects of the problem. The following is taken from the author's summary. The life-history of *Hyponomeuta padella* is described, and structural investigations of larvæ and adults confirm previous statements that the hawthorn and apple forms of *H. padella* are not distinct species. The chief criteria establishing the existence of a biological race are outlined. Investigations dealing with the food requirements of the larvæ, the oviposition and the mating preference of the adults, and the chromosome constitution of the different forms, are described. The results of breeding experiments constitute strong arguments in favour of regarding apple and hawthorn forms of *H. padella* as two biological races of one species. The economic aspect of the question is briefly discussed. M. E. M.

Head and Mouth Parts of the Codling-Moth Larva.—A. W. LOPEZ ("Morphological Studies of the Head and Mouth Parts of the Mature Codling-Moth Larva, *Carpocapsa pomonella* Linnæus," *Univ. Calif. Publ. in Entomology*, 1929, 5, no. 3, 19–36, 16 text-figs.). In view of the limited extent to which the morphology of this insect has been studied hitherto, the author in the present paper gives an account of the external anatomy of the head, mouth parts, the cranial anatomy and the central nervous system. The record by Bordas that certain lepidopterous larvæ, such as *Cossus ligniperda* F., have as a part of their mandibular glands a well-developed collection reservoir is substantiated, but dissections indicate that there is a difference in diameter in these glands. The nodulated portion is about 0.14 mm. in diameter and the posterior portion is only half that diameter. Whether or not this enlarged region can be construed as a reservoir is not certain, but a definite difference of diameter is exhibited. In regard to the labial palpi, the author's observations do not agree with those of Bordas in that, while Bordas shows the labial palpi with two terminal projections or setæ, Lopez' observations indicate a single terminal seta, and a second arising from the tip of the first segment. M. E. M.

Australian Neuroptera. VI.—P. ESBEN-PETERSEN ("Australian Neuroptera," *The Queensland Naturalist*, 1929, 7, no. 2, 31–5, 1 pl., 1 text-fig.). Amongst interesting material of Australian Neuroptera collected by Mr. L. Franzen of Brisbane the author has found new and undescribed species. The following genera and species are described: *Franzenia* n. gr., *Franzenia irrorata* n. sp. (*Myrmeleontidæ*), *Zachobiella submarginata* n. sp. (*Henerobiidæ*), *Neurorthis brunneipennis* n. sp. (*Sisyridæ*), *Theristriella stigma* n. gr. and n. sp. (*Mantispidæ*). M. E. M.

Physiology of Insects.—P. S. WELCH ("The Physiology of Insects: Metabolism," *Ann. Ento. Soc. of America*, 1928, 31, no. 3, 476–88). The author discusses in symposium form the comprehensive subject of insect metabolism. The term metabolism embraces a formidable array of fundamental processes, of which our latest knowledge is interestingly summarised under the three main headings: Circulation, Respiration, and Nutrition. Under these headings the principal work and results are outlined under the following sub-headings: Blood composition; blood pigments; reactions; blood-sugars; histological elements; functioning of the enclosing mechanism; gas interchange and related phenomena; differential respiration features; functions of air-stores; other lines of progress; transformations of foodstuffs; insect foods and their sources; vitamins and other nutritional features. Commenting on the evidence afforded by "reactions," the author states an opinion of considerable import in connection with pH investigations. "Without doubt, pH measurements are going to give us something of value when they are properly correlated with associated phenomena. I would offer here a word of

defence. In certain ecological circles a reaction against *pH*. measurements has appeared which unfortunately is sometimes misunderstood by those whose interests lie elsewhere. The reaction is not against *pH* as such, but against an over-emphasis, namely, the attempts of some investigators to make hydrogen-ion concentration an omnipotent determining factor in animal distribution, to the exclusion of other factors. This is a perfectly just reaction, but in no wise necessarily invalidates *pH* measurements elsewhere. Why discredit a worthy tool because it has met with misuse ? "

M. E. M.

New Species of Encyrtidae.—E. H. TIMBERLAKE ("Three New Species of the Hymenopterous Family *Encyrtidae* from New South Wales," *Univ. Calif. Publ. in Entomology*, 1929, 5, no. 2, 5-18, 5 text-figs.). The three species here considered were discovered by Mr. Harold Compere at Sydney, New South Wales, during his search for parasites of the citrophilus mealy-bug, *Pseudococcus gahani* Green. *Tetracnemus pretiosus* n. sp. and *Anusoidea comperei* n. sp. were definitely reared from this mealy-bug, and the former species is now being propagated and colonised in large numbers in California. The third species, *Anarhopus sydneyensis* n. sp., was not reared from a definite host, but a captured specimen oviposited freely in both *Pseudococcus gahani* Green and *Pseudococcus longispinus* Targ. without progeny resulting. Its exact host relationship, therefore, remains uncertain. The types of these three species herein described are deposited in the United States National Museum, and the paratypes, except as otherwise noted in the author's paper, are in the collection of the Citrus Experiment Station.

M. E. M.

A New Species of Coccophagus.—H. COMPERE ("Description of a New Species of *Coccophagus* recently introduced into California," *Univ. Calif. Publ. in Entomology*, 1929, 5, no. 1, 1-3, 2 text-figs.). The species herein described, *Coccophagus gurneyi* n. sp., is one of five species of beneficial insects recently introduced from New South Wales into California to aid in controlling the citrophilus mealy-bug, *Pseudococcus gahani* Green. This parasite is rapidly becoming abundant in certain orchards of Orange and Los Angeles counties, where it was first colonised.

M. E. M.

On Coleoptera, mostly from Queensland. Part II.—A. M. LEA (*Mem. Queensland Mus.*, 1929, 9, 335-63). Descriptions of species, many of which are new : includes many taken by Mr. Hacker in the National Park of Queensland, which is evidently a very rich locality.

E. W. B.

Bees in the Queensland Museum.—T. D. A. COCKERELL (*Mem. Queensland Mus.*, 1929, 9, 298-323). Descriptions of many new forms, with bionomic details.

E. W. B.

New Species of Australian Tingitidae.—H. HACKER (*Mem. Queensland Mus.*, 1929, 9, 324-34, 4 pls., 1 text-fig.). Fifteen new species, with descriptions in detail.

E. W. B.

Nematoda.

A New Nematode from the Stomach of a Scylloid Shark.—HSIEN WEN WU (*Cont. Biol. Lab. Sci. Soc. China*, 1927, 3, no. 2, 2 pls.). The scylloid shark is commonly sold in the markets of South Chinese coastal towns. The parasites, which the author has named *Paraleptus scylli* gen. et sp. nov., were found in the stomach of each of four sharks obtained from a market. A few specimens were also obtained from the gill pouch and pharynx of the sharks.

J. L.

A Critical Analysis of the Specific Characters of the genus *Acuaria* Nematodes of Birds, with Descriptions of New American Species.—OWEN WILLIAMS (*Univ. Calif. Publ. Zool.*, 1929, 33, 69–107). The author describes a simple biometrical method for distinguishing species of *Acuaria*, and employs it in the description of eight new species of this genus recovered from birds from Nebraska and California. J. L.

Revision of the Nematode Genus *Rusquiniella* Seurat, with a Description of a New Central American Species.—OWEN WILLIAMS (*Univ. Calif. Publ. Zool.*, 1929, 33, 1–12). Wedl's species of *Rusquiniella* is separated from *R. elongata* under the name of *R. wedli* nom. nov. A new species of *Rusquiniella* is described from the spotted ant bird *Hylophylax naevoides*, and the genus *Rusquiniella* Seurat 1919 is redefined and emended to include forms without lateral alæ. A complete host list is given. J. L.

Some New Cestode and Nematode Parasites from Tanganyika Territory.—J. H. SANDGROUND (*Proc. Boston Soc. Nat. Hist.*, 1928, 39, 131–50, 6 pls.). The material in this collection from Tanganyika Territory, in the region of the Usambura and Uruqura Mountains, consisted mainly of the inhabitants of the intestines of amphibians, reptiles, and mammals. *Ophiotaenia gatonica* is re-described, and also two new species of the same genus from snakes. Among the Nematodes an interesting new genus and species, *Acantho-oryuris anomaluri*, is described, and four new species are added to genera already established. J. L.

Trematoda.

Studies on the Trematode Family Strigeidæ (Holostomidæ). No. X. *Neascus bulboglossus* (Van Haltsma).—R. CHESTER HUGHES (*J. Parasitol.*, 1928, 15, 52–7, 1 pl.). A description of the metacercarian *Neascus bulboglossus*, specimens of which were found encysted in the integument, myotomes and gill arches of 15 out of 16 specimens of yellow perch, *Perca flavescens*, taken from Bersey Creek, Douglas Lake, Michigan. A comparison is made with *N. amblophilus*, which it closely resembles. J. L.

Studies on the Trematode Family Strigeidæ (Holostomidæ). No. XI. *Neascus pteichochylus* (Faust).—R. CHESTER HUGHES and FELIX R. PISZCZEK (*J. Parasitol.*, 1928, 15, 58–62, 1 pl.). The authors examined 25 specimens of *Notropis deliciosus stramineus* from Douglas Lake, Michigan. Twenty-two of this number showed infections with the metacercarian *Neascus pteichochylus* (Faust), the specimens being found encysted in the peritoneum of the body cavity and viscera and in cysts free in the ovaries. The metacercaria is here re-described in detail and compared with *N. van cleavei*, which it closely resembles. J. L.

Studies on the Trematode Family Strigeidæ (Holostomidæ). No. XII. *Agamodistomum* La Ruel sp. nov.—R. CHESTER HUGHES (*Parasitology*, 1928, 20, 413–20). The specimens described here were recovered by Prof. La Rue from the lungs of a racoon, *Procyon lotor lotor*, near Douglas Lake, Michigan. They closely resembled *Agamodistomum marciana* from the garter snake, *Thamnophis marciana*, and frogs, *Rana pipiens* and *R. clamabans*, and for this reason are not described in detail. The paper includes a synopsis of other agamodistomes, also a full reference list. J. L.

Studies on the Trematode Family Strigeidae (Holostomidae). No. XV.
Diplostomulum giga.—R. CHESTER HUGHES and PETER G. BERKHOUT (*Papers Michigan Acad. Sci., Arts & Letters*, 1928, **10**, 483–8, 2 pls.). A description of *Diplostomulum giga* sp. nov., found parasitic in the crystalline lenses of *Catostomus commersonii* from Douglas Lake, Michigan. This species very closely resembles *D. spathaceum* and may be identical with it. J. L.

Studies on the Trematode Family Strigeidae (Holostomidae). No. XVI.
Diplostomulum huronense.—R. CHESTER HUGHES and LUCILLA LANE HALL (*Papers Michigan Acad. Sci., Arts & Letters*, 1928, **10**, 489–94, 2 pls.). A new species of strigeid metacercaria, *Diplostomulum huronense*, was found unencysted in the eyes of the trout perch, *Percopsis omiscomayensis*, from Douglas Lake, Michigan. The specimens are described and figured. J. L.

Studies on the Trematode Family Strigeidae (Holostomidae). No. XVII.
Tetracotyle flatelliformis Faust.—R. CHESTER HUGHES (*Papers Michigan Acad. Sci., Arts & Letters*, 1928, **10**, 495–508, 1 pl.). A redescription of *Tetracotyle flatelliformis* Faust from specimens collected from snails at Douglas Lake, Michigan. The paper includes a synopsis of Tetracotyles parasitic in invertebrates. J. L.

The Host Relationship of the Trematode genus Zygorotyle.—E. W. PRICE (*J. Agric. Res.*, 1928, **36**, 911, 1 text-fig.). The amphistome *Zygorotyle lunata*, apparently normally parasitic in water birds, is reported for the first time in a domestic ruminant, *Bos taurus*. This is the second report of this species from ruminants, the first being from a deer, *Cervus dichotomus*. The following new bird hosts are reported for this trematode: *Anser anser domesticus*, *Gallinago delicata*, *Marila americana* and *Nettion carolinensis*. A comparison of specimens from the cow with specimens from water birds indicates that they are specifically identical, and that the recognition of *Zygorotyle ceratosa* as a distinct species is not justified. *Z. ceratosa* is therefore regarded as a synonym of *Z. lunata*. *Biological Abstracts*.

Cœlenterata.

Sexuality of Freshwater Hydroids as Experimentally Conditioned.—W. GOETSCH ("Die Geschlechtsverhältnisse der Süswasserhydroiden und ihre experimentelle Beeinflussung," *Ztschr. Wiss. Biol. Abt. D. Wilh. Roux' Arch. Entwicklungsmech. Organ.*, 1927, **111**, 173–249, 28 figs.). Offspring of *Hydra attenuata* produced by budding are characterised by similar sexuality under constant environment. Some, however, have a sexual period practically every month, but others do not form gonads in the course of a year. During eighteen months of observation ♂ and ♀ individuals kept under constant conditions neither changed sex nor became hermaphroditic; this was also true for their buds. Onset of sexual periods follows minimal changes of environment. Depression of the culture, resulting from such a change, may precede germ cell production. The unfavourable conditions produce reactions in the interstitial cells so that germ cells are produced from them, inaugurating the sexual period. Grafting ♂ and ♀ *H. attenuata* produces hermaphrodites only until the gonads already present are developed. In the following sexual periods the grafted animals are either wholly ♂ or wholly ♀. Buds present at the time of grafting, or produced soon after, have the sex of the graft from which they

grow, but later buds have the newly developed sex condition. After infection with symbiotic algæ the sex is often reversed, and then remains constant. Regeneration at the reproductive period reverses the sex in 60 p.c. of the cases; after reversal the sex remains constant. Temporary hermaphrodites may be produced by regeneration. Chance or artificially produced depressions may produce temporary hermaphroditism or permanent sex reversal. When sex reversal results, cells of gonads migrate into the endoderm and are resorbed. Sex reversal is, therefore, the result of inactivation of the germ cells of one sex. As regeneration experiments on *H. attenuata* may produce hermaphroditism, and many conditions cause changes in the nematocysts, it is probable that *H. attenuata* is not specifically distinct from *H. vulgaris*. Asexual as well as unisexual and hermaphroditic clones exist. It is likely that *Pelmatohydra oligactis* and *P. braueri* are related in the same way as *H. vulgaris* and *H. attenuata*. When the symbiotic relations of the hermaphroditic *Chlorohydra viridissima* were altered by removing the *Chlorella* or by replacing *Chlorella* with *Oocystis*, the animals became pure ♂ which persisted as such through two to eight sexual periods (nine to fifteen months). A modified hormone theory of sex is developed, by which the interstitial cells are the bearers of sex, remaining always capable of division and potentially immortal. They are of two kinds: (a) those in which sex is inhibited, primary soma cells; (b) those in which sex is already established as ♂ or ♀, primary germ cells. The mosaic structure of the hydra body out of primary germ cells of both sexes and primary soma cells is the result of the process of egg formation, in which interstitial cells of all kinds are included as yolk material. In cleavage these pass to the blastomeres and exert an hormonal effect upon their development, ♂, ♀ or indifferent complexes resulting according to the amount of hormone-producing cells of each sort present. The sex of the young hydra, and of its asexually produced progeny, will be determined by the balance struck between these various elements. *Biological Abstracts.*

Protozoa.

New Flagellates from Termites.—H. KIRBY, Jr. ("Snyderella and Coronympha, two New Genera of Multinucleate Flagellates from Termites." *Univ. Calif. Publ. Zool.*, 1929, **31**, 417–32, 2 pls., 2 text-figs.). Two new genera of polymastigide flagellates from termites are described. *Snyderella taboga* gen. n., sp. n., from *Kalotermes longicollis*, is rounded posteriorly, its anterior end being bluntly conical. Size $109 \times 73\mu$. The average number of nuclei is 45. They are not directly associated with mastigonts (in the Calonymphidæ the unit of structure is a mastigont comprising a parabasal, an axostyle, blepharoplasts and flagella. When associated with a nucleus this unit is termed a karyomastigont: when independent it is an akaryomastigont). The akaryomastigonts of *S. taboga* consist of four flagella, four blepharoplasts, an axostyle, a parabasal. *Coronympha clevelandi* gen. n., sp. n., from *Kalotermes* spp., is ovoid in shape and measures $30 \times 23\mu$. There are 16 nuclei in a circle at the anterior end of the body. Each is associated with a mastigont (karyomastigont) composed of four flagella, a chromatic basal rod, a blepharoplast, axostyle, a parabasal and a rhizoplast connecting blepharoplast to nucleus. The chromatic rod is connected with a trailing flagellum at its base. This is a new structure in the Calonymphidæ. Both flagellates are xylophagous.

C. A. H.

"Mitotic Flares" in Flagellates.—B. J. ANDREW and S. F. LIGHT ("Natural and Artificial Production of So-called 'Mitotic Flares' in the Intestinal

Flagellates of *Termopsis angusticollis*," *Univ. Calif. Publ. Zool.*, 1929, 31, 433-40). It has been observed that division-stages are very rarely encountered amongst the flagellates inhabiting the intestine of termites. It was also assumed that the death-rate of these protozoa was very high. These facts led to the conclusion that epidemics of divisions ("mitotic flares") occurred periodically. The present work is concerned with the elucidation of this phenomenon. The termite used for the investigation was *Termopsis angusticollis*. It was found that the death-rate in the intestinal flagellates of this insect was actually very low, and having reached the optimum number the fauna remains fairly constant, without multiplying any further. During the moulting process the termites lose a large proportion of their intestinal parasites ("defaunation"). Normal "refaunation" occurs by reinfection from other individuals of the colony, and could be produced by artificial feeding. It is in the course of this "refaunation" that intense multiplication ("mitotic flares") takes place.

C. A. H.

New Species of Suctoria.—A. E. NOBLE ("Two New Species of the Protozoan genus *Ephelota* from Monterey Bay, California," *Univ. Calif. Publ. Zool.*, 1929, 33, 13-26, 2 pls., 3 text-figs.). Two new species of *Ephelota* are described from Pacific Grove, California. *E. gigantea* sp. n. has the following dimensions: Body—length 518μ , height 148μ , thickness 145μ ; stalk— $1098 \times 30\mu$; prehensile tentacles— $500 \times 4\mu$; suctorial tentacles— $11 \times 3\mu$; external bud— $180 \times 148 \times 78\mu$. This form is found attached to seaweeds. *E. minima* sp. n. is a much smaller form. The body is 70μ in diameter; pedicel 52μ long; the length of prehensile tentacles is 82μ , and that of the suctorial tentacles 18μ . Reproduction in both species is the same as that in other members of the genus. *E. minima* was found attached to the bodies of a crustacean, *Caprella acutifrons*.

C. A. H.

A New Genus of Gregarines from a Californian Cricket.—L. M. SMITH ("*Cacospora stenopelmuli* gen. nov., sp. nov., a Gregarine from *Stenopelmatus* (Orthoptera) from Central California," *Univ. Calif. Publ. Zool.*, 1929, 33, 57-68, 2 pls.). The new genus resembles *Hyalospora*, but differs from it "in having spherical rather than ellipsoidal spores, and white rather than yellow-orange endoplasm." The trophozoite measures on the average 65 microns (including epimerite, proto- and deutomerite), while the average length of a sporont (without epimerite) is over 339 microns. Association of the sporonts takes place in the mid-gut, in which the trophozoites are also found. Cysts are formed in the hind gut. The spores, which are spherical, smooth, $4.8-5.0$ microns in diameter, are liberated by a single rupture of the cyst. The parasite was successfully passed through the host, its life-cycle averaging 23 days. The time for ripening of the spore is about 10 days, making the full life-cycle about 33 days. The hosts are crickets, *Stenopelmatus pictus* and *S. fuscus*.

C. A. H.

New Ciliates from a Sea-Urchin.—J. E. LYNCH. ("Studies on the Ciliates from the Intestine of *Strongylocentrotus* I. *Entorhipidium* gen. nov.," *Univ. Calif. Publ. Zool.*, 1929, 33, 27-56, 3 pls., 2 text-figs.). The ciliates described belong to the order Holotrichida, family Chiliferidæ, and are assigned to a new genus, *Entorhipidium*, characterised as follows: Body large ($155-350\mu$), flattened, triangular in outline. Width $0.3-0.7$ of length, thickness $\frac{1}{3}$ of width. Posterior end drawn out into a "tail," sometimes terminating in a bristle. A frontal lobe extends across anterior end of body. Mouth dorsal near right border, posterior to frontal lobe, permanently open; oral cavity with long cilia. Inconspicuous oesophagus. Trichocysts present. Macronucleus near centre of body. One large or several small

micronuclei anterior to macronucleus. Several vacuoles on dorsal right side. The four species comprising the genus, *E. echini*, *E. tenue*, *E. pilatum*, *E. multimicronucleatum* spp. n., are all parasitic in the intestine of *Strongylocentrotus purpuratus*, from Pacific Grove, California.
C. A. H.

Plasmodium in the Blood of a Pangolin.—F. DE MELLO, M. F. FERNANDES, F. CORREA, and M. LOBO ("Etudes sur la sang de *Manes pentadactyla* L.," *Arq. Escola Med.-Cir., Nova Goa*, 1928, ser. A, 513-16, 1 pl.). A new plasmodium, *P. tyrio* sp. n., from the blood of an Indian pangolin, *Manis pentadactyla* (erroneously spelt "*Manes*" in the original). The development of the parasite takes place mainly in the peripheral circulation. The earlier stages resemble the ring-forms of *P. falciparum*. The schizonts are always considerably smaller than the red-cells. Apparently the maximum number of merozoites produced is eight. The gametocytes are rounded or oval; the male ones, with a large nucleus and very little pigment, stain feebly by May-Grunwald's method, whereas the female gametocytes have a small nucleus and coarsely granular dark pigment, the cytoplasm staining blue.
C. A. H.

Life-Cycle and Syngamy in Myxobolus.—A. NAVILLE ("La meiose, la fécondation et la dihaplophase de *Myxobolus guyenoti* sp. n.," *Zeitschr. f. Zellforsch. u. mikr. Anat.*, 1928, 7, 228-56, 2 pls., 2 text-figs.). The author describes the life-cycle and sexual processes in *Myxobolus guyenoti* sp. n., parasitic in the gills of *Perca fluviatilis* (Lake of Geneva). The uninuclear amœboid body ("sporoplasme") escapes from the spore and by a process of schizogony gives rise to a small plasmodium with numerous nuclei. These undergo karyokinetic division, the resulting nuclei being diploid (four chromosomes). At this stage the nuclei are in the pre-meiotic phase. They then undergo meiotic divisions which reduce the number of chromosomes to two (haploid nuclei). In this process small and large mononuclear bodies are formed within the plasmodium. The former elongate and give rise to microgametes, while the latter become macrogametes. The gametes conjugate, forming a zygote. The zygotes divide further, producing diploid binuclear young sporonts ("pan-sporoblastes"). From these, spores of two types are developed, "spores monosporées" and "disporées." In both cases a reduction division takes place, the ripe sporont having either eight or fourteen haploid nuclei, two of which are residual. The fully formed spore contains one sporoplasm with two haploid nuclei which ultimately fuse ("copulation") to form a single diploid nucleus.
C. A. H.

On the Genus Pseudospora.—G. O. ROSKIN ("Zur Kenntnis der Gattung *Pseudospora* Cienkowski," *Arb. a. d. Microbiol. Inst., Moscow*, 1928, 4, 1-13 Russian text, 357 German résumé, 13 text-figs.). A description of the morphology and life-cycle of two species of *Pseudospora* parasitic on some Volvocidæ. *P. eudorinæ* sp. n., a parasite of *Eudorina elegans*, differs from *P. volvocis*, from *Volvox*, in the structure and dimensions of its cysts, which are provided with two membranes. The author revises the systematic position of *Pseudospora*, which was formerly regarded as a primitive Heliozoon, and places it in the family Bistadiidæ (Amœbidæ).
C. A. H.

Nuclear Division in Trypanosomes.—G. O. ROSKIN and S. S. SCHISCHLAJEWA ("Zur Frage des Mechanismus der Kernteilung bei Trypanosomen," *Arb. a. d. Mikrobiol. Inst., Moscow*, 1928, 4, 14-8 Russian text, 357-8 German résumé, 3 text-figs.). ("Die Kernteilung bei Trypanosomen," *Arch. f. Protistenk.*, 1928,

60, 460-81, 1 pl., 6 text-figs.) The authors describe the mechanism of nuclear division in *Trypanosoma pecaui* (= *T. brucei*), *T. suauru* (= *T. evansi*), and *T. gambiense*. The preparations were fixed in Flemming's solution and stained with iron hæmatoxylin or treated by Feulgen's method. In these trypanosomes the chromatin is disposed along the periphery of the nucleus. The karyosome contains no chromatin, and does not stain by Feulgen's method. In the initial stages of division the peripheral chromatin passes into the karyosome, which now shows a positive reaction to Feulgen. The karyosome then swells and breaks up into three chromatin-staining granules. These granules, which the authors regard as chromosomes, become arranged in a row parallel to the long axis of the body, and each divides into two. At this stage the entire nucleus is drawn out and divides into two portions, each daughter-nucleus receiving three chromosomes. In the new nuclei the chromosomes fuse, giving rise to a karyosome. Finally the chromatin leaves the karyosome and becomes arranged on the periphery, the nucleus again assuming its normal structure. Apparently no centrosomes or spindles are formed in the process described. C. A. H.

The Protozoa of Forest Soils.—D. FEHAR and L. VARGA ("Untersuchungen über die Protozoen-Fauna des Waldbodens," *Centralb. Bakt. II. Abt.*, 1929, 77, 524-42, 4 charts). The authors have made a quantitative and qualitative analysis of the soil protozoa of some Hungarian forests. Lists of forms found in the soil of various types of forest are given, and these are correlated with the meteorological and other physical factors observed in the course of the investigation. In comparison with cultivated soils the forest soils appear to be poor in protozoa, amongst which amœbæ are predominant. In most cases the protozoa are found in the encysted state. Apparently the most essential factor in the development of the protozoan fauna is the humidity of the soil, other factors—such as temperature, humus-content, pH, humidity of the atmosphere—being of secondary importance. C. A. H.

Eocene Greensands of Texas.—J. A. CUSHMAN and N. L. THOMAS ("Abundant Foraminifera of the East Texas Greensands," *Jour. Palæont.*, 1929, 3, no 2, 176-84, 2 pls.). The Mount Selman greensand (Eocene) has a wide distribution in Texas, and its outcrops form the lines for the main arteries of transportation. It has a thickness up to 100 feet, and consists of glauconite pellets in a non-calcareous clayey iron-stained matrix. Fossils, both mega- and micro-, are very abundant, but poorly preserved. While the foraminifera are limited in species, the number of individuals is large, and the character of the fauna is fairly uniform. Ten species are described and figured, of which two are new. A. E.

Tertiary Foraminifera from Jamaica.—T. WAYLAND VAUGHAN ("Species of Large Arenaceous and Orbitoidal Foraminifera from the Tertiary Deposits of Jamaica," *Jour. Palæont.*, 1928, 1, no. 4, 277-98, pls. 43-50). The specimens dealt with in this paper were collected by C. A. Matley in 1921-4 while Government geologist of Jamaica. They all belong to the two families Orbitolinidæ and Orbitoididæ, and, generally speaking, consisted of rock specimens which could only be studied in thin sections. The species are listed according to their apparent stratigraphic position, and range from Middle Eocene to Oligocene, the Miocene species being reserved for description in a further paper. Seven new species are described and figured. A. E.

Some Pliocene Lagenæ.—J. A. CUSHMAN ("Pliocene Lagenas from California," *Cont. Cush. Lab. For. Res.*, 1929, 67-72, 1 pl.). The Pliocene Lagenæ

of Southern California are very close to, and in most cases identical with, the species now living off the same coast. Eighteen species are described and figured, ten of which are identical with the species listed but not figured in the author's paper on "Foraminifera from off the West Coast of America (1927)." One of the species, *L. angelina*, is new. A. E.

Arenaceous Foraminifera.—J. A. CUSHMAN and J. A. WATERS ("Some Arenaceous Foraminifera from the Taylor Marl of Texas," *Cont. Cush. Lab. For. Res.*, 1929, 63-6, 1 pl.). Some of the abundant arenaceous foraminifera of the Cretaceous of Texas and other parts of the Gulf Coastal Plain region of the United States are very close to those of Europe, and others are identical, but some are new. They are often of large size, and some are good horizon markers for stratigraphic work. Four new species referable to the genera *Frankeina*, *Lituola*, *Haplophragmium* and *Ammobaculites*, are figured and described, all under the same specific name *Taylorensis*, after the Taylor Marl in which they are found. A. E.

A New Arenaceous Genus.—J. A. CUSHMAN and C. I. ALEXANDER (" *Frankeina*, a New Genus of Arenaceous Foraminifera," *Cont. Cush. Lab. For. Res.*, 1929, 61 2, 6 figs. on plate). *Frankeina goodlandensis* from the Upper Cretaceous of Texas is stated to be close to *Flabellamina* and *Ammobaculites*. The most striking point is the unusual position of the angles of the test. In *Frankeina* the angle is on the ventral surface, whereas in *Saracenaria* and similar uncoiled forms of triangular section the angle is dorsal. It is suggested that some of the angular species from the Upper Cretaceous of Europe which were transferred by Franke from *Haplophragmium* to *Ammobaculites* on account of their planispiral early stage may, on subsequent examination in section, prove to belong to *Frankeina*, and the authors suspect that *Verneuilina variabilis* Brady, now living in the Pacific, may prove to be a living representative of the new genus. A. E.

Study of an Early Type.—J. A. CUSHMAN ("On *Quinqueloculina seminula* (Linné)," *Cont. Cush. Lab. For. Res.*, 1929, 59-60, 5 figs. on pl.). Continuing his studies of the earlier described species of foraminifera, the author deals with a species which has perhaps as many references as any in the literature of the subject. *Serpula seminulum* Linné is described in the 12th edition of the *Systema Naturæ* (1767), and Gmelin in the 13th edition bases the type on the earlier figures of Plancus (1739), and Gualtieri (1742). At Rimini on the Adriatic, the locality of Plancus and Gualtieri, the author found that the commonest species is still a *Quinqueloculina* which exhibits little variation. This he figures and regards as Linné's original type of the species. The synonymy of the species is very extensive and requires revision. The name *Quinqueloculina seminulum* (Linné) should be applied only to "a smooth quinqueloculine form, with rounded or very slightly angled chambers, with a truncated apertural end, and the aperture with a single tooth." The Rimini type is well illustrated, and there is a reproduction of Gualtieri's figure. A. E.

The Genus *Siphogeneroides*.—J. A. CUSHMAN ("Some Species of *Siphogeneroides* from the Cretaceous of Venezuela," *Cont. Cush. Lab. For. Res.*, 1929, 55-9, 5 figs. in pl.). The genus *Siphogeneroides* was founded on a single species, *S. plummeri*, from the Upper Cretaceous of Texas. The genus is reviewed in the light of three new species from the Upper Cretaceous of Venezuela which are to be regarded as useful stratigraphic markers, their vertical ranges being strictly limited. A. E.

Development of Foraminifera.—J. A. CUSHMAN ("The Term 'Arenaceous Foraminifera' and its Meaning," *Cont. Cush. Lab. For. Res.*, 1929, 25-7). The sequence of development in the Foraminifera has been from the nude forms to those with a chitinous test, then to the arenaceous, and finally to the perforate calcareous test. Arenaceous tests are frequently very abundant in shallow tropical waters where the sand is calcareous, and arenaceous types in such habitats are built of calcareous grains. The essential character of the test is agglutination, whether the percentage of cement is high or low, and whether the particles used are large or fine. Many of the arenaceous calcareous forms may become perforate, and the development may be seen in sections of *Textularia* where the early chambers are of closely agglutinated grains without pores, the later chambers having a lining of secreted calcareous porous material. This in the adult may form a considerable proportion of the shell wall. All such arenaceous agglutinate tests, whatever the proportion of cement, are to be distinguished from those tests of higher forms which are directly secreted by the protoplasm and are of uniform structure. They have undoubtedly developed from the habit of cementing materials together. Once the power of secreting the entire test was attained, the ornamentation of the test which reaches such development in recent foraminifera was brought into play. Complexity of growth and specialised structure were impossible with the primitive arenaceous test, and an advance in structure only came about when the animal learned to use particles of foreign matter sufficiently fine to be subordinated to the architectural lines of the test.

A. E.

Species of Bolivina.—J. A. CUSHMAN ("The Genus *Bolivina* and its Species," *Cont. Cush. Lab. For. Res.*, 1929, 28-34, 1 pl.). The genus *Bolivina* Cushman, 1927, was instituted for the reception of *Textularia folium* Parker and Jones, 1865, a well-known tropical species. It is not related to *Textularia*, being calcareous and perforate. It differs from *Bolivina* inasmuch as the aperture is at right angles to the plane of compression, instead of in that plane, as in *Bolivina*. The records of *T. folium* go back to the Upper Eocene of both Europe and Australia. In the present oceans the genus is confined to the Indo-Pacific, with a somewhat restricted distribution even in that faunal area. Four new fossil species and one new recent variety are described and figured.

A. E.

Three Early Types of Polymorphina.—Y. OZAWA ("On *Guttulina lactea* (Walker & Jacob), *Polymorphina burgdigalensis* d'Orbigny and *Pyrulina gutta* d'Orbigny," *Cont. Cush. Lab. For. Res.*, 1929, 34-9, 1 pl.). Brady, Parker and Jones in 1869 fixed all the species of *Polymorphina* then known in what they regarded as a natural sequence, but the nomenclature of the Polymorphinidæ still offers many difficulties, and an attempt is now being made to fix and rearrange all known species as far as possible. The three species cited in the title are among the oldest described, and the type specimens have all disappeared, but an examination of material from the localities mentioned by the original authors has generally resulted in the finding of specimens comparable with their published figures.

A. E.

Foraminifera from Lower Oligocene.—J. A. CUSHMAN ("Notes on the Foraminifera of the Byram Marl," *Cont. Cush. Lab. For. Res.*, 1929, 40-8, 2 pls.). Since 1922-3, when two papers on the subject were published by the United States Geological Survey, numerous additions to the foraminiferal fauna of the Byram Marl have been discovered. Five new species and a new variety are figured and described.

A. E.

A New Virgulina.—J. A. CUSHMAN ("An American *Virgulina* related to *V. pertusa* Reuss," *Cont. Cush. Lab. For. Res.*, 1929, 53-4, 8 figs. in plate). Describes

and figures *Virgulina floridana*, a new species from the Miocene of Florida, and contrasts it with its nearest ally, *V. pertusa* Reuss, a typical fossil of the German Miocene, which is also figured for comparison. A. E.

Foraminifera from a New Locality.—J. A. CUSHMAN and R. T. D. WICKENDEN ("Recent Foraminifera from off Juan Fernandez Islands," *Proc. U.S. Nat. Mus.*, 1929, no. 2780, 1-16, 6 pls.). The Juan Fernandez area of the Pacific represents an almost unknown region so far as the Foraminifera are concerned. as the *Challenger* and *Albatross* dredgings made in the neighbourhood were in deep water. The paper deals with the examination of a collection of small samples taken with a snapper lead in depths of 10-20 fathoms in Cumberland Bay, Juan Fernandez Island. The fauna is interesting on account of its associations with other regions. Some of the species are evidently East Indian or Australian in their relationships. Others are more closely connected with the cold water faunas known to exist on the west coasts of North and South America. The balance consists of pelagic species and others of world-wide distribution. Six new species and a new variety are described and figured. Among the records of most interest is *Fischerina (Rotalia) dubia* (d'Orbigny), known hitherto only from two West Indian records. The paper is well and fully illustrated. A. E.

More Orbitoid Foraminifera.—T. WAYLAND VAUGHAN ("Species of *Orbitocyclina*, a Genus of American Orbitoid Foraminifera from the Upper Cretaceous of Mexico and Louisiana," *J. Paleont.*, 1929, 3, no. 2, 170-5, 1 pl.). *Orbitocyclina* is a genus of orbitoidal foraminifera, the genotype of which is *Lepidorbitoides minima* H. Douvillé, from the Upper Cretaceous of Cardenas, Mexico. *Polylepidina cardenasensis* Galloway is a synonym. A new species, *O. nortoni*, has been found in the Upper Cretaceous of Louisiana. Both species are described and figured. A. E.

New Orbitoidal Foraminifera.—T. WAYLAND VAUGHAN (" *Actinosiphon semmesi*, a New Genus and Species of Orbitoidal Foraminifera, and *Pseudorbitoides trechmanni* H. Douvillé," *J. Paleont.*, 1929, 3, no. 2, 163-9, 1 pl.). The paper contains a description of *Actinosiphon semmesi*, a new genus and species of orbitoidal foraminifera from the Lower Eocene of Mexico, and a full description of Douvillé's species, which had not previously been described adequately. *Actinosiphon* has no very apparent relationship to other orbitoidal foraminifera. It is nearest to *Pseudorbitoides*, from which it differs by its single layer of equatorial chambers and the stoloniferous passages through the walls of chambers belonging to the same radial series. There are no radial markings as in *Pseudorbitoides*. A. E.

Orbitoidal Foraminifera.—T. WAYLAND VAUGHAN ("Studies of Orbitoidal Foraminifera: the sub-genus *Polylepidina* of *Lepidocyclina* and *Orbitocyclina*, a New Genus," *Proc. Nat. Acad. Sci.*, 1929, 15, no. 3, 288-95, 1 pl.). The orbitoidal foraminifera discussed are of interest from the standpoint of stratigraphic geology, and also of the possible phylogenetic relations of the group. The new genus *Orbitocyclina* occurs in the Upper Cretaceous of Eastern Mexico. *Polylepidina* is known only from the Eocene. Both *Orbitocyclina* and *Polylepidina* are very close to *Orbitoides*, from which they differ in the features of the embryonic chambers of the megalospheric form. The ancestry of the Orbitoids must be sought in a phylum probably represented by *Planorbulina* or some allied form, as Hofker has already suggested. A. E.

A Question of Nomenclature.—T. WAYLAND VAUGHAN ("A Note on the Names *Cyclosiphon* Ehrenberg 1856 and *Lepidocyclina* Gumbel 1868,"

J. Palæont., 1929, 3, no. 1, 28-9). The question has been raised whether the generic name *Cyclosiphon* or *Lepidocyclus* should be used for the genus of which *Nummulites mantelli* Morton is the genotype. Ehrenberg's name has priority, and was associated by him with *N. mantelli*, but it has never been used by later authors. Ehrenberg's types in Berlin are stated to represent a number of different organisms, few, if any, of which are identifiable as *Lepidocyclus*. Because of the confusion surrounding the identification of *Cyclosiphon*, and the greater confusion which would be occasioned by its revival, it appears desirable that the use of *Lepidocyclus* should be continued.

A. E.

Eocene Fossils from Florida.—M. WILCOX MOBERG ("New Species of *Coskinolina* and *Dictyoconus*? from Florida," 19th Ann. Rep. Florida State Geol. Sur., 1928, 166-75, 3 pls.). Contains descriptions and figures of a new species of *Coskinolina* (*C. Cookei*) and of a suspected *Dictyoconus* (*D. gunteri*). A positive identification of the genus in the latter case is stated to be impossible with the material available.

A. E.

Fossil Foraminifera from Florida and Georgia.—T. WAYLAND VAUGHAN ("New Species of *Operculina* and *Discocyclus* from the Ocala Limestone," 19th Ann. Rep. Florida State Geol. Sur., 1928, 155-65, 2 pls.). In an introductory note the author comments on the complexity of the specific and varietal names of the larger foraminifera, notably in the genus *Lepidocyclus*, and suggests a scheme of revision. There is a list of all the larger foraminifera known from the Ocala Limestone of Georgia and Florida, and four new species are described and figured.

A. E.

Revision of Polymorphina.—J. A. CUSHMAN and Y. OZAWA ("A Revision of Polymorphinidæ," *Jap. Jour. of Geol. and Geography*, 1929, 6, no. 11, 79-83, 1 pl., 1 text-fig.). The authors consider that the classification of specimens usually assigned to *Polymorphina* is a complex problem. The biserial arrangement of chambers is developed independently from different sources, and there is a tendency to develop uniserial forms. The relationship of the wall and the terminal radiate aperture to the Lagenidæ is marked, but the typical arrangement is a spirally sigmoid series very different from anything seen in the Lagenidæ. In section certain species resemble *Sigmoilina* in the Miliolidæ, but the wall is perforate and the series is a true spiral about an elongate axis, with the aperture always at the same end. The most primitive form is the spirally arranged *Guttulina*, which probably arose from the coiled forms of Lagenidæ. From *Guttulina* two main series are developed, one typically with the chambers more or less globular, the other typically with the chambers elongate. There is an elaborate discussion of the further developments in each series, and the paper closes with a table showing the relationships of the 14 genera and sub-genera into which it is proposed to divide the hitherto accepted genus *Polymorphina*, and a diagrammatic plate illustrating their suggested evolution.

A. E.

Polymorphinidæ from Japan.—J. A. CUSHMAN and Y. OZAWA ("Some Species of Fossil and Recent Polymorphinidæ found in Japan," *Jap. Jour. Geol. and Geography*, 1929, 6, no. 10, 63-78, pls. xiii-xvi). The material described is from "younger Tertiary formations" in the Island of Sado, Province of Kaga, which may be divided into an upper group characterised by warm water foraminifera such as *Operculina* and *Miogyopsina*, and a lower group containing cool water species of Miliolids, *Cassidulina*, *Polymorphina*, etc. The specimens are described under a new system of classification devised by the authors in their "Revision of the Poly-

morphinidæ," and must be studied in connection with that paper (see previous abstract). The paper is prefaced by clear definitions of the proposed new genera and sub-genera, and is well illustrated. A. E.

Atlantic Foraminifera.—J. A. CUSHMAN ("Foraminifera of the Atlantic Ocean. Part 6. Miliolidæ, Ophthalmitidæ and Fischerinidæ," *U.S. Nat. Mus.*, 1929, *Bull.* 104, i-viii., 1-129, pls. 1-22). This work, which professes to be a compilation of the species recorded from the Atlantic, has been in process of publication for several years, with the usual delays inseparable from such a vast undertaking. Since 1924, when the last part was issued, the author has published a new system of classification for the order, which is now adopted, and will be used in the two parts which remain to be published. A brief analysis of the new classification is included in the report. A work of this nature involves much laborious research, and omissions are perhaps inevitable. As its value to the systematist rests on its completeness, it is to be hoped that the author will in due course issue a supplement including the many species published since the commencement of the work, and such omissions as may be discovered. Two such have been noticed by the abstractor, viz., *Planispirina* (*Biloculina*) *sphæra* (d'Orbigny), which is not included, and *Quinqueloculina venusta* Karrer, which is figured but not otherwise referred to. The plates are good, much better than in some of the earlier parts. A. E.

A Study in Relationships.—J. A. CUSHMAN ("The Genus *Trimosina* and its Relationships to other Genera of the Foraminifera," *J. Washington Acad. Sci.*, 1929, 19, no. 8, 155-9, 1 text-fig.). Cushman has already separated the form figured by Millett in this Journal (1900, 548, pl. iv, fig. 13) as *Mimosina spinulosa* Millett var. to form the new genus *Trimosina*. Such forms are stated to be abundant in the Indo-Pacific, and two new species from Fiji are described and figured. *Trimosina* is derived from *Reussia* Schubert, and the new species fill in the stages from that genus to *Chrysalidinella* Schubert. They have no connection with the Cretaceous genus *Chrysalidina* d'Orbigny, which has an arenaceous test and is derived from *Verneulina*. A. E.

A Fossil Pegidia.—J. A. CUSHMAN ("A Fossil Member of the Family Pegidiidæ," *J. Washington Acad. Sci.*, 1929, 19, no. 6, 125-7, 1 text-fig.). Describes and figures a new species, *Pegidia karreriana*, from the Miocene of Kostež, Banat, Hungary, a deposit of shallow water tropical character already well known from Felix Karrer's paper published in 1868. At first glance the surface of the new species resembles that of *Sphæridia papillata* Heron-Allen & Earland, but the structure places it in *Pegidia*. It is nearest to *P. pulvillus* H.-A. & E., but the surface is more coarsely ornamented, and the biconvex form of the fossil species is more nearly symmetrical than in the recent one. This is the first known fossil representative of a family described so recently as 1928 in this Journal, and the author is to be congratulated on having so speedily verified the prognostication that as the wide distribution of the family connoted a prolonged ancestry, the early stages of its evolution might yet be found in tropical deposits. A. E.

Eocene Discocylinæ from Mexico.—T. WAYLAND VAUGHAN ("Descriptions of New Species of Foraminifera of the Genus *Discocyclus* from the Eocene of Mexico," *Proc. U.S. Nat. Mus.*, 1929, no. 2800, 76, art. 3, 1-18, pls. 1-7). Describes and figures seven new species and one new variety of *Discocyclus* from Mexican localities ranging between Lower and Upper Eocene. Previously no Lower Eocene species of this genus have been described from America except *D. cristensis* (Vaughan), which is also dealt with in this paper. One of the new

species, *D. perpusilla*, is peculiar in that the annular siphon between the chambers of the same ring is situated next the distal instead of next the proximal wall of the chambers. In *D. cloptoni*, another new species, the two initial chambers are often doubled, trebled, or quadrupled. As the specimens of *D. perpusilla* were extraordinarily well preserved, the minute structure was studied by Hofker's impregnation and decalcification method, but no definite trace of a canal system was observed.

A. E.

Foraminifera from West Coast of South America.—J. A. CUSHMAN and B. KELLET ("Recent Foraminifera from the West Coast of South America," *Proc. U.S. Nat. Mus.*, 1929, no. 2796, 75, art. 25, 1-16, pls. 1-5). Since d'Orbigny published the results of his South American voyage in 1839, practically nothing has been written about the foraminiferal fauna of the West Coast of South America. The paper records the results of the study of samples of bottom deposits collected from numerous localities between Ecuador and Chile by Dr. Waldo L. Schmidt, of the United States National Museum. Some of the samples are from d'Orbigny's original localities, and many of that author's species have been rediscovered. The fauna of the northernmost sample from Santa Elena, Ecuador, is tropical, with West Indian affinities, differing greatly from the samples from the colder waters to the south, the species from which appear to be very distinctive. Very few of the species recorded in the southern area are identical with those found in the adjacent Pacific at Juan Fernandez Island; even the dominant genera are different. Five new species are described, and all the forms listed are well figured.

A. E.

Nuclear Division in *Leishmania tropica*.—G. ROSKIN and K. ROMANOWA ("Die Kernteilung bei *Leishmania tropica*," *Arch. Protistenk.*, 1928, 60, 428-91, 1 pl., 4 text-figs.). Nuclear division in *Leishmania tropica* is very similar to that in trypanosomes. In the resting nucleus the chromatin is distributed peripherally on the nuclear membrane. There is a central karyosome which stains very intensely with iron-haematoxylin, but which gives a negative reaction with Feulgen's chromatin test. The peripheral chromatin disappears and the karyosome becomes chromatic as division approaches, and finally breaks down successively into three chromosomes, each of which divides into two daughters. The six daughter chromosomes are arranged in two parallel rows, and finally form two groups of three chromosomes each. The groups pass to opposite poles of the nucleus, which divides and forms two daughter nuclei. The karyosome is reformed in each daughter nucleus by fusion of the chromosomes; the chromatin then leaves the karyosome and takes up the position characteristic of the resting nucleus; the karyosome again becomes achromatic. In the process the division of the cytoplasm has taken place. The blepharoplast shows a positive reaction to the Feulgen test for chromatin.

Biological Abstracts.

The Bell-Toads and their Opalinid Parasites.—M. M. METCALF (*Amer. Nat.*, 1928, 62, 5, 3 text-figs.). A discussion is given of the geographical distribution of the bell-toads (*Discoglossidae*) and their opalinid parasites, and evidence presented: (1) that the family, an ancient one, is now decadent; (2) that it arose in Eastern Asia and spread westward to Europe by a route north of the Himalaya Mountains (*Bombina*, *Discoglossus*, *Alytes*), north-eastward to the Pacific coast of Asia (*Bombina*) and North America (*Ascaphus*), and south-eastward across Australia to New Zealand (*Liopelma*). *Ascaphus* has no opalinids in the adult, but its tadpoles, which live as larvæ over winter, carry *Protoöpalina stejneri*, similar to the *Protoöpalinas* of the Euro-Asian bell-toads. *Liopelma* has no free larval stage and so no opalinids, but some Australian hylids and leptodactylids bear *Protoöpalinas* of the

sub-genus characteristic of the bell-toads, and probably left by ancestors of *Liopelma* in their passage across Australia to New Zealand. A new sub-family, *Liopelminae*, is proposed for *Bombina*, *Ascaphus* and *Liopelma*; another new species of *Protoopalina*, from *Bombina maxima*, is mentioned, but not named nor described.

Biological Abstracts.

The Bacteriological Sterilisation of Paramecium.—A. K. PARPART (*Biol. Bull. Marine Biol. Lab.*, 1928, **55**, 113–20). The technique for sterilising *Paramecium* consists of washing each animal ten times in sterile media under sterile conditions. Each animal must be left in the fifth wash for five hours before passing it up to the tenth. This time interval is necessitated by the fact that *Paramecia* externally free from bacteria still have bacterial spores within them, and must be given time to defecate these.

Biological Abstracts.

Influence of Salts on Food Vacuoles of Paramecium.—V. DOGIEL and M. ISSAKOWA-KEO ("Physiologische Studien an Infusorien. II. Der Einfluss der Salzlosungen auf die Ernährung von Paramecium," *Biol. Zentralb.*, 1927, **47**, 577, 8 text-figs.). In m/64 $MgCl_2$ and m/50 or m/128 $MgSO_4$ the food vacuoles of *Paramecium* sp., as shown by ingested ink, do not break off from the inner end of the gullet, but form a long band with three to four loops which may be called an "ink intestine." This "ink intestine" forms an extraordinarily large globular food vacuole after about twenty minutes. Thereafter ingestion is normal. In m/100 or weaker $FeSO_4$ a similar "ink intestine" is formed, but here the ink is usually extruded through the wall of the gullet instead of forming a large food vacuole. In m/1000 $BaCl_2$ the food vacuoles formed are spindle-shaped and only one-fifth to one-tenth the usual size.

Biological Abstracts.

Nuclear Changes in Separated Conjugants of Stylonychia mytilus and Paramecium caudatum.—S. A. ILOWAISKY ("Über die Kernprozesse der getrennter Conjugaturn der *S. Mytilus* und *P. caudatum*," *Arch. Protistenk.*, 1926, **53**, 243–52, 12 figs.). By forcefully separating conjugants, fixing one member at once as a control, then fixing the others at stated intervals after separation, it was determined that nuclear reorganisation went on to completion, much as in normal conjugation. The old macronucleus was resorbed and a new nuclear apparatus developed out of the division products of the micronuclei. In *Stylonychia* the micronuclei were in division by five and a half hours after separation, and the macronuclei were also dividing by a regular process of division instead of by fragmentation. By twenty-two hours after separation there were sixteen division products from the micronuclei, and one of these had begun to develop into a macronucleus. This one anlage and two micronuclei persist, all the other nuclear bodies being resorbed. In the majority of cases the one macronucleus divided, establishing the typical vegetative condition. These animals grew and divided in a normal manner. A few animals failed to complete reorganisation and died. In some few others all traces of micronuclei disappeared and the macronucleus divided into two. These amiconucleate individuals lived and divided for as long as three and a half weeks. In *Paramecium*, also, reorganisation of the nuclear apparatus takes place in separated conjugants, but peculiarities have been observed which require further study.

Biological Abstracts.

Notes on Heteromita.—M. ROBERTSON (*Parasitology*, 1928, **20**, 10–24, 1 pl.). A species of *Heteromita* considered to be *H. globosa* is discussed. The organism is biflagellate, with the two unequal flagella arising from two basal granules or blepharoplasts situated close together at the anterior end of the body. There

is a karyosome nucleus with an achromatic karyosome. The chromatin lies on or around the periphery of the karyosome as a narrow diffuse layer, and is also distributed upon the inner side of the nuclear membrane. A study is made of the living organism, which is cultivated on water agar (or egg agar) flooded with Peters' medium. The division, encystation and excystation are described from both living and stained material. Nuclear division is characterised by a well-developed spindle, and the chromatin is arranged in an equatorial plate at the metaphase. The blepharoplasts play the part of centrosomes in the division of the nucleus. A process of delayed division was observed. If, after the division of the nucleus and the drawing apart of the main bulk of the protoplasm, the actual breaking of the narrow junction between the two daughters fails to take place immediately, there seems to be no means of effecting the separation until the occurrence of a new nuclear division. The result of this is the production of a double individual with two nuclei and a double flagellar apparatus. In the course of a few hours, usually three to six, a second division occurs, and each nucleus undergoes mitosis and the creature splits into four daughters. The double individuals may encyst, and when they emerge they do so as a single binucleate protozoon equipped with a double flagellar apparatus. Syngamy was not observed.

Biological Abstracts.

Gigantism in Protozoa.—A. E. REYES ("El gigantismo en los protozoarios," *Rev. mexicana Biol.*, 1927, 7, 119–20). The orbitoid foraminifera are cited as an excellent illustration of the resort to gigantism by a group of organisms immediately preceding extinction. Other data are given as to the ecologic conditions under which the animals lived.

Biological Abstracts.

Infection Experiments with *Hydræma hydroxema* nov. gen.—B. D. REYNOLDS and J. B. LOOPER (*J. Parasitol.*, 1928, 15, 23–30, 1 pl., 1 text-fig.). An experimental study is made of *Hydræma*, based on *H. hydroxema*. Entz placed this species in the genus *Amœba* because he did not consider it to be pathogenic to its host, *Hydra*. In these experiments it is shown that the amœbæ are very pathogenic, causing death of host usually in three to eight days. Furthermore, the amœbæ are unable to live in a habitat suitable for free-living amœbæ for more than six to eight days after being removed from their host. The amœbæ may be found on the tentacles, peristome, body surface, and in the enteric cavity of infected polyps, but they are probably capable of thriving only as external parasites. They may be readily transferred from *Pelmatohydra oligactis* to *Hydra viridis* and *vice versa*, but they have not been successfully transferred to representatives of other phyla.

Biological Abstracts.

The Nutritive Requirements of *Paramecium*.—M. K. HANSEN ("Some Studies of *Paramecia*, concerning their Isolation, Sterilisation and Nutritive Requirements," *Acta Path. Microbiol. Scandinavia*, 1927, 4, 1–38, 1 fig.). Series of laboratory tests made to ascertain the most suitable methods of isolating and culturing *Paramecia* showed that they thrive best in association with bacteria, which presumably supply their vitamin needs. A pipette "trap" was devised for picking out single *Paramecia* and washing them free of bacteria. Incubating tube cultures of *Paramecia* in air at 37° C. for 42–85 minutes tends to kill off the accompanying foreign protozoa. The hay infusion for the *Paramecia* is best autoclaved for at least six hours; the destroyed vitamins may be supplied by freshly-killed *paramecia* or bacteria. Milk autoclaved for long periods yields an excellent nutrient medium. Bacteria may play a part in the vitamin production for higher animals.

Biological Abstracts.

BOTANY.

(Under the direction of A. B. RENDLE, D.Sc., F.R.S.)

GENERAL.

Cytology.

Chromosome Arrangement in *Sagittaria* and *Lythrum*.—NAMIO SHINKE ("Chromosome Arrangement. IV. The Meiotic Divisions in Pollen Mother-Cells of *Sagittaria Aginashi* Makino and *Lythrum Salicaria* L. var. *vulgare* DC., sub-var. *genuina* Koehne," *Mem. Coll. Sci., Kyoto Imp. Univ.*, B., 1929, 4, 283-308). In *Sagittaria Aginashi* the haploid chromosome number is 11. In late diakinesis one large M chromosome and one small *a* chromosome can be distinguished from the other 9 bivalents. In the heterotype metaphase the chromosome arrangement resembles that of the stable form of floating magnets in 53.8 p.c. of the cases examined, i.e. 8 chromosomes are in a peripheral ring while 3 occupy the central region. The small *a* chromosome has a strong tendency to take a central position, while the large M chromosome is usually on the periphery of the group. In the homotypic division the chromosomes become greatly elongated and rarely arrange themselves as in heterotypic metaphase. In *Lythrum* two types of pollen mother-cell exist, one with 15, one with 14 bivalent chromosomes. In the latter case one chromosome is tetrapartite. In both types of pollen mother-cell the form of chromosome arrangement resembling the arrangement of the floating magnets occurs most frequently, i.e. 5 central chromosomes in the 15 chromosomal form, and 4 central chromosomes in the 14 chromosomal form. Four central chromosomes are, however, frequently found in the 15 chromosome type, and 5 in the 14 chromosome type. When the tetrapartite chromosome is present it is usually in a peripheral position. J. L.

Chromosome Arrangement in *Torilis* and *Peucedanum*.—KIN-YA OGAWA ("Chromosome Arrangement. V. Pollen Mother-Cells in *Torilis Anthriscus* Bernh. and *Peucedanum japonicum* Thunb.," *Mem. Coll. Sci., Kyoto Imp. Univ.*, B., 1929, 4, 309-22). The following chromosome numbers are given for plants of the Umbelliferae: *Torilis Anthriscus* $n = 8$, *Petroselinum sativum* $n = 11$, *Cicuta virosa* $n = 11$, *Foeniculum vulgare* $n = 11$, *Ligusticum acutilobum* $n = 11$, *Angelica pubescens* $n = 11$, *A. sylvestris* $n = 11$, *Angelica* sp. $n = 33$, *Phellopterus littoralis* $n = 11$, *Peucedanum japonicum* $n = 11$, *P. decursivum* $n = 11$, *Pastinaca sativa* $n = 11$. Both 11 and 8 may be regarded as the basic chromosome numbers in the Umbelliferae. In both *Torilis Anthriscus* and *Peucedanum japonicum* the chromosomes are nearly all of uniform size and shape, and in the meiotic divisions their arrangement is most frequently that of the stable form of floating magnets, i.e. with one central chromosome in *Torilis* and three central in *Peucedanum* in over 67 p.c. of the cases of each examined. The resemblance to the arrangement of floating magnets is less marked in the homotypic divisions of *Peucedanum*. J. L.

Chromosome Arrangement in *Spinacia* and *Vicia*.—TAKESHIGE MAEDA and KAZUO KATÔ ("Chromosome Arrangement. VII. The Pollen Mother-Cells of *Spinacia oleracea* Mill. and *Vicia Faba* L.," *Mem. Coll. Sci., Kyoto Imp. Univ.*, B., 1929, 4, 327-45). The haploid chromosome number in both *Spinacia oleracea* and *Vicia Faba* var. *megalosperma*, is six. In each case, in the heterotypic metaphase, one geminus is distinctly larger than the other five. In both plants the chromosome arrangement resembles most frequently the arrangement of floating magnets, and occurs in 69.7 p.c. and 71.1 p.c. respectively of the cases examined. One chromosome takes up a central position surrounded by the other five. The central chromosome is determined merely by chance irrespective of its size. J. L.

Chromosome Arrangement in a Triploid *Narcissus*.—SEIJIN NAGAO ("Chromosome Arrangement. VIII. The Heterotype Division of Pollen Mother-Cells in a Triploid Variety of the *Narcissus* Plant," *Mem. Coll. Sci., Kyoto Imp. Univ.*, B., 1929, 4, 347-52). In the triploid variety "*Poetarum*" of *Narcissus* there are seven trivalent chromosomes in the heterotypic nuclear plate. In 65.3 p.c. of the cases observed, these arrange themselves in a similar manner to that of floating magnets, i.e. a ring of six and one in the centre. If cases of the "progressive" form are included, i.e. cells which have probably been fixed before all the chromosomes take up their final positions, the total percentage of cases resembling the arrangement of magnets is 81.4. In cases in which some of the trivalent chromosomes are separated into uni- and bi-valent components, the separated elements rarely occupy the central position. J. L.

Chromosome Arrangement in *Cycas*.—TAKESHI NAKAMURA ("Chromosome Arrangement. IX. The Pollen Mother-Cells in *Cycas revoluta* Thunb.," *Mem. Coll. Sci., Kyoto Imp. Univ.*, B., 1929, 4, 353-69). In the pollen mother-cells of *Cycas revoluta* the bivalent chromosomes are of various shapes and form a graded series in respect to size. In 132 cases out of 140 examined, the number of gemini is 11, while the remaining 8 cases show 12. When 12 chromosomal elements are present, a pair of elements lying near each other is generally found. In every case two very large gemini are distinct from the others, and in many cases a geminus smaller than all the others can be distinguished. In the homotypic division, of which only a few cases could be counted, 11 chromosomes only are found. The chromosome numbers for the endosperm and nucellus tissue are found to be 12 and 24 respectively. The chromosome arrangement was investigated in the pollen mother-cells with 11 chromosomal elements, and the most frequent form of arrangement was found to differ from the stable form of the floating magnets. In 44.16 p.c. of the cases observed, two central chromosomes are surrounded by a ring of nine, while 32.5 p.c. have three central chromosomes in a ring of eight—i.e. the arrangement assumed by the floating magnets. The two large bivalents have not been observed to lie in the central region simultaneously. J. L.

Structure of Cytoplasm around the Blepharoplast.—YOSHINARI KUWADA and TAKESHIGE MAEDA ("On the Structure of the Cytoplasm around the Blepharoplast in *Cycas revoluta* Thunb.," *Mem. Coll. Sci., Kyoto Imp. Univ.*, B., 1929, 4, 165-74). In healthy living material of *Cycas revoluta* the blepharoplast lies at the centre of a hyaline region in which there is no indication of a radiation figure. The cytoplasm of the rest of the body cell is alveolar in structure. In fixed material a beautiful system of rays is formed in the area immediately surrounding the blepharoplast. The general appearance of the ray figure is different with different fixing fluids. If in living material the cells are unhealthy or dying, the hyaline region shows an alveolar structure, and the alveolar walls run convergently to the

blepharoplast, thus presenting an appearance of rays. It is suggested that the hyaline area is a colloid, and the alveolar structure that gives the appearance of rays round the blepharoplast is merely coagulation due to unfavourable conditions or caused by fixatives. Similar observations have been made on *Ginkgo biloba*. Thus while the astral structure round the centrosome in living animal cells can be seen and touched with micro-dissection needles, there is no such structure round the blepharoplast.

J. L.

Contraction of Chromosomes.—JOHN BELLING ("Contraction of Chromosomes, during Maturation Divisions in *Lilium* and Other Plants," *Univ. Calif. Publ. Bot.*, 1928, 14, 335-43). Measurements are given of the length of thread and approximate volume of chromatin in pachyphase, early and late diaphase, metaphase and anaphase of the pollen mother-cells of species of *Lilium* and *Aloë*. The contraction in length in both *Lilium* and *Aloë* from pachyphase to metaphase was to about one-tenth of the original length of the pachyphase thread. Of this, a contraction to one-third might have occurred through the approximation of the pachyphase chromosomes, while the rest of the contraction is probably the result of corrugation or zig-zagging of the chromosomes. In *Agapanthus* and *Kniphofia* partial contraction caused by the approximation of chromosomes is visible after zygophase. Portions of the pachyphase thread are conspicuously thickened, the number of these thickened portions corresponding to the number of bivalent chromosomes, i.e. 15 and 6 in *Agapanthus* and *Kniphofia* respectively. Parallel conjugation of the paternal and maternal chromosomes has therefore occurred before pachyphase. Polar granules are observed in *Agapanthus*.

J. L.

Chromosomal Configurations of Trivalents of Hyacinthus.—JOHN BELLING ("Nodes and Internodes of Trivalents of *Hyacinthus*," *Univ. Calif. Publ. Bot.*, 1929, 14, 379-88). Diagrams and figures are given of the chief chromosomal configurations of the diploid and triploid forms of *Hyacinthus*. Triploid configurations cannot be explained by the hypothesis of alternate separation of homologues and of sister strands, except with an additional hypothesis. The hypothesis of separation between homologues, with previously formed chiasmata, explains the triploid as well as the diploid configurations.

J. L.

Narcissus Chromosome Numbers and Meiosis in a Triploid.—SEIJIN NAGAO ("Karyological Studies of the Narcissus Plant. I. Somatic Chromosome Numbers of Some Garden Varieties and Some Meiotic Phases of a Triploid Variety," *Mem. Coll. Sci., Kyoto Imp. Univ.*, 1929, B., 4, 175-98). The somatic chromosome numbers were determined in root tips of some garden varieties of the following species of *Narcissus*: *N. Pseudonarcissus*, *N. incomparabilis*, *N. Bulbocodium*, *N. poeticus*, *N. Tazetta*, *N. poetas*, *N. Jonquilla*, and the following range of numbers observed: 14, 20, 21, 22, 25, 28, 30, 32, 42. Among the 19 varieties studied there are 5 diploid, 4 triploid, 2 tetraploid, 1 hexaploid and 7 heteroploid. Meiosis has been studied in the triploid variety *N. poeticus poetarum*. In diakinesis and metaphase 7 trivalent elements are present. At anaphase two triplets of a trivalent element are separated regularly to the poles, while the third element undergoes a random distribution. Some of these third elements (varying in number from 1-7) may lag at the equator of the spindle and split longitudinally, and their halves then separate towards the poles. This behaviour results in different combinations and different numbers of chromosomes at the poles. In the homotypic division the monad chromosomes do not split again, but undergo chance distribution and frequently lag on the spindle. Micronuclei often result from the heterotypic as well as the homotypic division. Phenomena are observed which resemble the formation

of a restitution nucleus, and diads or triads are seen as well as normal tetrads at pollen formation. J. L.

Smear Method for Chromosomes.—JOHN MILTON WEBBER ("A Smear Method for the Study of Chromosomes in Microsporogenesis," *Univ. Calif. Publ. Bot.*, 1929, **14**, 345–52). The technical details are given of a smear method for pollen mother-cells, using acetic alcohol as a fixative and Delafield's hæmatoxylin or iron brazilin as a stain. In many plants the hæmatoxylin method has yielded good preparations of all the nuclear changes involved in microsporogenesis. The advantages of smears thus treated over the paraffin method are considered. J. L.

Chromosome Linkage in *Oenothera*.—F. M. L. SHEFFIELD ("Chromosome Linkage in *Oenothera*, with Special Reference to Some F_1 Hybrids," *Proc. Roy. Soc., B.*, 1929, **105**, 207–30). A cytological study has been made of the meiotic divisions in the pollen mother-cells of several F_1 hybrids of *Oenothera*. The nuclear stages prior to second contraction appear to be similar in all *Oenothera* species, hybrids and mutants, but on emerging from the second contraction knot, each reveals its characteristic ring formation of chromosomes. The amount of pairing and chromosome linkage is constant in each hybrid. The chromosome configurations are as follows: *Oe. eriensis* \times *ammophila* 12 in a ring and 1 pair, *Oe. ammophila* \times *eriensis* 14 in a ring, *Oe. ammophila* \times *novæ-scotiæ* 14 in a ring, *Oe. ammophila* \times *rubricalyx* 6 in a ring and 4 pairs, *Oe. eriensis* \times *rubricalyx* 12 in a ring and 1 pair, *Oe. rubricalyx* \times *eriensis* non-viable, *Oe. rubricalyx* \times *novæ-scotiæ* 12 in a ring and 1 pair. Non-disjunction of chromosomes resulting in 6–8 divisions occurs in approximately 9–12 p.c. of the cases examined for each hybrid. Double non-disjunction was also frequently observed. The discussion deals with such problems as the correlation existing between chromosome linkages and the genetical behaviour of *Oenothera*, the hypotheses seeking to account for the formation of rings of chromosomes, and the evidence favouring a tentative hypothesis of the inheritance of chromosome arrangement as a genetic character. J. L.

Chromosome Linkage in *Oenothera*.—R. R. GATES and F. M. L. SHEFFIELD ("Chromosome Linkage in Certain *Oenothera* Hybrids," *Phil. Trans. Roy. Soc., B.*, **217**, 367–94). Five generations of hybrids from *Oe. (biennis* \times *rubricalyx*) \times *ammophila* and the reciprocal cross are described. The reciprocal F_1 generations are very different. The F_1 of *Oe. (biennis* \times *rubricalyx*) \times *ammophila* contained two types which differed only in having light or dark green leaves. In F_2 two families resembled *rubricalyx*, while a third segregated into two types: A with dark green leaves and erect stems, and B with light green leaves and bent stems. In the subsequent generations these types bred true in the main. The F_1 of *Oe. ammophila* \times (*biennis* \times *rubricalyx*) contained a single type B^1 . In F_2 three families bred true and two segregated into the types A and B, which resembled the original parents of the cross. In later generations type A bred true, B produced B and A, and B^1 bred true. When the A and B types were crossed, they produced an F^1 of A and B plants. Both the reciprocal triple hybrids and all their descendants have the dominant red bud colour of *Oe. rubricalyx*. A hypothesis, involving the assumption that non-homologous chromosomes may pair, is put forward to explain this. An account is given of the cytology of the reduction divisions in the pollen mother-cells of the reciprocal hybrids. The chromosome linkages are different in these hybrids. In *Oe. ammophila* \times (*biennis* \times *rubricalyx*) there are in diakinesis three free pairs of chromosomes and a ring of eight. When *Oe. ammophila* has been used as the pollen parent, the hybrid has seven chromosome ring pairs. Presumably

this difference is due to the influence of the cytoplasm contributed by the egg cell, but which only shows itself at the time of meiosis. Since a triple hybrid has all its chromosomes paired, it is obvious that complete pairing cannot be regarded as a sign of the homozygous condition. The tentative hypothesis may be held that the linkage of chromosomes in *Oenothera* has arisen between non-homologous chromosomes as a result of crossing. J. L.

Effects of X-Rays and Radium on *Nicotiana*.—T. H. GOODSPEED ("The Effects of X-Rays and Radium on Species of the Genus *Nicotiana*," *Jour. Hered.*, 1929, 20, 243-59). A general account is given of the morphological and cytological effects of X-rays and radium on species of *Nicotiana*. The polymorphic species *N. rustica* var. *pumila* is very like *Tabacum* in producing qualitative and quantitative changes in nuclear material after X-ray treatment of sex cells. Greater stability under treatment is characteristic of relatively monotypic species or in general of species with lower chromosome numbers. The same situation follows treatment with the gamma rays of radium. The stage of maturity of the sex cells has little relation to the effectiveness of X-radiation. Ungerminated seeds are very resistant to X-rays, and no lethal effect has so far been observed. The initial rate of germination is retarded, but at maturity no effect can be seen on the size and vigour of the plants. Seedlings are very susceptible to treatment, and lethal effects are easily produced. The plants which survive show permanent as well as transient differences in growth and form. J. L.

Variant Plants Produced from X-Rayed Sex Cells of *Nicotiana*.—T. H. GOODSPEED ("Cytological and Other Features of Variant Plants produced from X-Rayed Sex Cells of *Nicotiana Tabacum*," *Bot. Gaz.*, 1929, 87, 563-82). A description is given of the mode of treatment of plants of *Nicotiana Tabacum* var. *purpurea* with doses of X-rays and of the immediate effects of these rays. Large numbers of variants appear in the selfed progeny of plants whose sex cells have been thus irradiated. There is evidence that irradiation of mature pollen can bring about variation. The variations which occur include most of the vegetative and floral characters, also the fertility and cytological conditions at the meiotic divisions. The length of exposure of sex cells to X-rays is apparently directly connected with the occurrence of variants in the offspring: the longer the exposure, the greater the total number of variants. The percentage of variants is higher when one set of sex cells is in the meiotic stages than when both are mature at treatment. Cytological examination shows that the variants can be classified roughly into four groups: (1) those normal in chromosome number and behaviour, exhibiting 24 bivalents at heterotypic metaphase; (2) those showing non-conjunction of one or more pairs of chromosomes, accompanied by lagging on the spindle and the formation of a large number of microcytes; (3) those which are the products of non-disjunctive phenomena and at heterotypic metaphase show either 23 bivalents and 1 univalent (monosomic), 24 bivalents and 1 univalent (trisomic), 22 bivalents and 1 univalent or 23 bivalents; (4) those which possess fragmented chromosomes. The monosomic and trisomic variants do not resemble in external morphology any monosomic or trisomic *Tabacum* which has previously arisen in the author's cultures. J. L.

Cleistogamous Flowers of *Viola*.—MARGARET MADGE ("Spermatogenesis and Fertilization in the Cleistogamous Flower of *Viola odorata* var. *præcox* Gregory," *Ann. Bot.*, 1929, 43, 543-77). Flowers of three types, chasmogamous, semi-cleistogamous, and cleistogamous, are borne by *Viola odorata* var. *præcox*. A comparative description is given of these three flower types. Seeds are not set by

the chasmogamous flowers. Pollen grains of two forms are found in the anthers of all three types. The grains are either ovoid or round ridged. In the chasmogamous flowers it is the ovoid grains which germinate, and the round ridged grains are believed to be merely an immature condition. In the cleistogamous and semi-cleistogamous flowers the round ridged grains are mature and germinate, while the ovoid degenerate. Germination of the grains inside the undehiscent anthers is a marked feature in all three types of flower. In the chasmogamous type the pollen tubes mostly remain inside the anther, while in the other two types the pollen tubes grow through the anther wall and out on to the stigma. Chromosome counts show the haploid number to be 10. The early stages of pollen development are quite regular, likewise the formation of the eight-nucleate embryo sac. Definite male cells are formed in the pollen tubes. The protoplasmic sheaths of these male cells are shed as the tube discharges its contents on to the egg cell. At the time of fertilisation the egg and polar nuclei have all their stainable material concentrated in a large nucleolus, but the male nuclei possess a definite reticulum. True fertilisation occurs. During triple fusion the second male nucleus fuses completely with one polar nucleus, while the other polar nucleus may remain distinct until the first division occurs. At this first division of the primary endosperm nucleus two groups of chromosomes, one diploid and one haploid, are distinguishable. J. L.

Chromosome Numbers of Cottons.—ILABONTO BANERJI ("The Chromosome Numbers of Indian Cottons," *Ann. Bot.*, 1929, **43**, 603-7). The chromosome numbers of twenty-eight Indian and four acclimatised American cottons have been determined. The haploid numbers are 26 for the American and 13 for the Indian forms. These numbers are in agreement with those previously obtained for the Old and New World cottons. J. L.

Anatomy.

The Shape of Massed Cells.—F. T. LEWIS ("The Shape of Cork Cells," *Science*, 1928, **68**, 625-6, 2 figs.). It is demonstrated that a cork cell on the average makes fourteen contacts with the cells which surround it. This shape is significant, since Lord Kelvin found that tetrakaidecahedra solve the problem of dividing space without interstices into uniform bodies of minimum surface. Cork cells are intermediate between the orthic and prismatic forms of the tetrakaidecahedron.

B. J. R.

Structure of the Cell Wall.—G. J. RITTER ("Composition and Structure of the Cell Wall of Wood," *Ind. and Eng. Chem.*, 1928, **20**, 941-5, 17 figs.). Observations of wood cross-sections after alternate swelling and shrinking with alkali and acid indicate that the cell wall is composed of several layers so closely packed or so embedded in a cementing substance that they are invisible in the original wood. The existence of layers can also be demonstrated by treating delignified wood fibres alternately with phosphoric acid and a dehydrating agent such as alcohol. Radial sections so treated show checks through the bordered pits which correspond to the fibril structure assumed from the optical properties. By the two methods outlined above the fibres of thin longitudinal sections, delignified by the method of Cross and Bevan, were separated into layers sufficiently thin to make the spacings visible. The fibrils which compose the various layers of the cell wall can be separated by chemical means. Those of the outer layer lie at approximately 90 degrees to the long axis of the fibre. A second discontinuous layer which is sometimes present has the fibrils at about 45 degrees. In the remaining layers the fibrils form an angle of from 0 to 30 degrees to the long axis.

B. J. R.

Cell Growth and Cell Division.—J. H. PRIESTLEY ("Cell Growth and Cell Division in the Shoot of the Flowering Plant," *New Phytol.*, 1929, **28**, 54-81, 3 figs., 1 pl.). The living parenchyma cells of the shoot apex pass through three phases: (1) the meristematic cell, (2) the vacuolating dividing cell, and (3) the vacuolated extended cell, which has ceased to divide. The meristematic cell is a fluid aggregate with a plastic wall. Its shape is determined by external pressure, and the cells lie closely pressed together without intercellular spaces. The position of a new division wall seems to be determined by the shape of the cell, and forms in a plane of minimum area, but there are exceptions. The vacuolating dividing cell rounds itself off by an internal hydrostatic pressure directed against an elastic cellulose wall which thickens with time, so that groups of cells can be distinguished as arising from different common parents by the relative thickness of the walls and the size of the intercellular spaces. The position of the new division wall seems again to be determined by the shape of the cell, but is not the result simply of external pressure, as in the case of the meristematic cell. The vacuolated cell may extend greatly in volume at the time when it ceases to manufacture protoplasm and divide. It is suggested that "sliding growth" is only possible in the stage of the vacuolating dividing cell. At this stage the cells are relatively rigid through turgidity, and the middle lamella still plastic. It is suggested that (a) the meristematic phase, in which all the protoplasm is engaged in protoplasmic synthesis, is only maintained when the liquid surrounding the cell has a pH near the iso-electric point of the main constituent protein of the cell; (b) the vacuolating dividing cell, in which the nucleus alone synthesises protoplasm, can exist over a wider range of pH, but still requires an aqueous environment; and (c) the vacuolated extended cell ceases to divide and usually extends greatly in volume when air replaces water in the intercellular spaces.

B. J. R.

The Distinction between Vessels and Tracheids.—F. J. MEYER ("Über Gefässbrechungen und die Frage der Unterscheidung von Gefässen und Tracheiden," *Jahrb. f. Wiss. Bot.*, 1929, **71**, 161-83, 9 figs.). The vessels of *Hydrastis* and *Uragoga* possess open perforations. The width of the perforations, expressed as a percentage of the diameter of the vessels, is considerably less than the width of the perforations of typical vessels like those of *Cucurbita*, *Viola*, and *Pteridium*. The distinction between vessels and tracheids is considered from three standpoints. From the standpoint of development there exist numerous intermediate forms between tracheids and vessels, e.g., the Gnetaceæ. From a purely morphological standpoint, considering the relative width of the perforations, the vessels of *Hydrastis* and *Uragoga* are regarded as intermediate forms. From a physiological-anatomical point of view the vessels of these two genera play the same rôle.

B. J. R.

Radial Pitting in Callixylon.—C. A. ARNOLD ("On the Radial Pitting in *Callixylon*," *Amer. Jour. Bot.*, 1929, **16**, 391-3, 2 figs.). The bordered pits on the radial walls of the tracheids are arranged in radially aligned groups with unpitted spaces between. The explanation of the grouping of the pits is apparent in a recently discovered silicified specimen. In the unpitted space between the pit groups an intercellular transverse band is visible which is interpreted as a bar of Sanio.

B. J. R.

Regeneration of the Stem Apex.—MARY PILKINGTON ("Regeneration of the Stem Apex," *New Phytol.*, 1929, **28**, 37-53, 20 figs., 2 pls.). Regeneration after decapitation, a median split, or a prick, is shown to occur in *Vicia Faba* and *Lupinus albus*. Only that part of the growing point which lies above or between the youngest leaves is capable of giving rise to a new apex. Consequently regeneration depends

on the presence of a sufficiently large surface area of the original growing point between the wound and the youngest lateral members. In no case did regeneration take place from the wound surface. Two new growing points are only formed when they are separated by a longitudinal split. B. J. R.

Secondary Wood of the Monimiaceæ.—M. B. WELCH ("Notes on Some Australian Timbers of the Monimiaceæ," *J. & Proc. Roy. Soc. N.S. Wales*, 1928, 62, 350–65, 4 pls.). The genera *Doryphora*, *Atherosperma* and *Daphnandra* of the Atherospermeæ furnish close-textured, "pine-like" timbers usually without any characteristic figure. *Hedycarya*, *Mollinedia* and *Kibara* of the Monimieæ possess woods with large prominent rays. Growth-rings are not clearly defined, and there is no distinction between sapwood and heartwood. The vessel segments are very long, up to 2.5 mm., and possess scalariform end perforations. Tracheids are rarely present, the mechanical tissue consisting of wood fibres or fibre tracheids. Septate wood fibres were found in all genera except *Mollinedia*. Vertical wood parenchyma is sparsely distributed. The rays are heterogeneous. B. J. R.

Anomalous Thickening in the Amarantaceæ.—WERNER SCHMID ("Das anomale sekundäre Dickenwachstum der Amarantaceæ," *Festschrift Hans Schinz, Beiblatt zur Vierteljahrsschrift der Naturf. Gesellschaft, Zürich*, 1928, 15, 542–53, 2 pls.). The anomalous feature of the family is the development of extra-fascicular vascular bundles. The anomalous thickening originates in the pericycle, certain cells of which assume meristematic activities and give rise to collateral vascular bundles. Successively, further cambial layers may arise, and a concentric system of bundles be formed outside the central cylinder. The ground tissue surrounding the secondary bundles may consist entirely of parenchyma or entirely of sclerenchyma, or of both kinds of cell. The primary pericycle may be circular or undulating in outline. The number of extra-fascicular zones of growth is variable, and bears no constant relation to the number of annual growth periods. Anomalous secondary thickening in the root follows the same lines as in the stem. B. J. R.

Nature of the Pitting between Tracheary and Parenchymatous Elements.—F. H. FROST ("Histology of the Wood of Angiosperms, I," *Bull. Torr. Bot. Club.*, 1929, 56, 259–64, 1 pl.). The prevalent conception that the pits in the walls of parenchyma cells in contact with vessels are always simple is shown to be incorrect. Fully bordered, half-bordered and simple pits are characteristic features between tracheary cells and vascular parenchyma. The type of pitting on the wall of the parenchyma cell is controlled largely by the degree of specialisation of the vessel or fibre which lies next to it. Exceptions to this rule occur in groups which possess the heterogeneous type of ray, in which cases the upright parenchyma cells often show a different type of pitting from the radially elongated ray parenchyma elements. The detailed structure of vessel-parenchyma pits is useful in wood identification. In transitional genera, such as *Sambucus*, it is possible to differentiate between species by the occurrence of bordered or simple vessel-ray pits. In closely related genera, like *Liriodendron* and *Magnolia* or *Salix* and *Populus*, the details of the pittings are usually identical. B. J. R.

Fasciation in *Campanula carpatica*.—W. C. WORSDELL ("The Structure of Fasciated Plants of *Campanula carpatica* Jacq.," *New Phytol.*, 1929, 28, 150–61, 8 figs., 1 pl.). The fasciated stem replaces the basal branching system, the individual components of which are very narrow in diameter. The author regards the fasciated stem as a single structure which is due to specially luxuriant growth. He regards it as the equivalent of the main stem, along with its numerous basal lateral branches,

in the normal plant. In its upper part the fasciated stem endeavours to give expression to the lateral branches which it contains *in potentia* within itself. The phenomenon is not regarded as being due to congenital fusion. B. J. R.

Embryology and Germination of *Typhonodorum Lindleyanum*.—L. A. BOODLE and A. W. HILL (" *Typhonodorum Lindleyanum* : Development of the Embryo and Germination of the Seed," *Ann. Bot.*, 1929, 43, 437–50, 26 figs., 1 pl.). The ovary contains one or two, rarely three, ovules. Mucilage is present in its cavity and is formed by glandular hairs on internal ridges which may represent modified parietal placentas. The ovules are basal, erect and orthotropous with two integuments, the outer one being the more strongly developed. Digestion of the nucellar tissue lateral to the embryo-sac takes place at an early stage, an apical cap of nucellus remaining for a time. The embryo-sac produces a number of outgrowths or branches which extend towards the periphery of the ovular tissue. The original part of the embryo-sac becomes differentiated into an upper, narrow, and a lower swollen portion. Early complete filling of the embryo-sac with endosperm does not take place, the endosperm being restricted for a considerable time to the upper portion of the embryo-sac. The young embryo has a short suspensor. As the embryo increases in size, its upper end bursts through the inner integument, while its lower part grows downwards, absorbing most of the endosperm around it. There is no arrest in the development of the embryo, which consists of two distinct portions, an upper, dense, corm-like body, at the apex of which lies the developing plumule, and a spherical spongy body which is the haustorial portion of the cotyledon. It is considered probable that the corm-like body is either a specialised portion of the cotyledon or a lateral hypocotyledonary outgrowth which acts as a store of reserves for the young seedling. The haustorial portion has a secondary function as a "float" enabling the seed to float upright when shed into water. B. J. R.

Morphology of *Zostera marina*.—W. A. SETCHELL (" Morphological and Phenological Notes on *Zostera marina* L.," *Univ. Calif. Publ. Bot.*, 14, 389–452, 59 figs.). The first stage of growth extends from the germination of the seed to the production of the first turion at the tip of the caulicle. The second stage extends from the beginning of growth of the first turion to the formation of the second turion and the lateral buds. The third stage includes (a) development of the second turion into the erect flowering shoot, through anthesis, fruiting, death and detachment for floating; (b) development of axillary buds into lateral rhizome segments, each with a terminal turion and lateral buds; (c) dying away of the main axis of the rhizome, leaving the lateral rhizome segments free. The rhizome axis is sympodial in its development, while the erect flowering axis of each season is monopodial. The number of rhizome segments increases year by year in geometric progression. They become separated, and in a few years very numerous, each representing a new individual through disjunction of both the older rhizome segments and the erect flowering segments of the season. The main variations within the species are var. *angustifolia*, var. *typica*, var. *stenophylla* and var. *latifolia*. B. J. R.

The Megagametophyte of *Hartmannia tetraptera*.—D. A. JOHANSEN (" Studies in the Morphology of the Onagraceæ—I," *Bull. Torr. Bot. Club*, 1929, 56, 285–98, 1 fig., 1 pl.). Guignard's description of an octonucleate megagametophyte for *Hartmannia* (*Oenothera*) *tetraptera* is not confirmed; the species is as regularly tetranucleate as any other species of the Onagraceæ. The species is in a transitory stage, as evidenced by cytological behaviour in the megaspores, megagametophytes, and microsporocytes. The probable method of cell-wall formation

in the embryo-sac is described. The filiform apparatus and the indentations characterising the synergids are entirely normal structures. The normal haploid number of chromosomes is 7, the diploid 14, but some variation exists. B. J. R.

The Microgametophyte and Megagametophyte of *Agropyron repens*.—M. MOWERY ("Development of the Pollen Grain and the Embryo Sac of *Agropyron repens*," *Bull. Torr. Bot. Club.*, 1929, 56, 319–24, 2 pls.). Microsporogenesis and megasporogenesis are described. In the male and female gametophytes the sporogenous tissue develops from the outer layer of the periblem. The ovule shows a slight indication of a funiculus. The form of the ovule is half-anatropous.

B. J. R.

Anatomy of Flowers in Relation to Insects.—E. VAN HAY ("Insectes et fleurs, quelques observations personnelles," *Bull. Soc. Roy. Bot. Belgique*, 1928, 61, 68–70). Notes on the anatomy of bee-pollinated flowers in relation to the movements of the insects in obtaining access to the nectar: species of *Borago*, *Geranium*, *Salix*, *Erica*, *Calluna*, *Brassica*, *Ribes*, *Trifolium* and *Dielytra*. From observations on differently coloured varieties of *Campanula medium grandiflora* it appears that the bees do not distinguish between the blue, pink and white flowers. The amount of nectar produced is dependent on the quality of the soil in which the plant grows. Lucerne forms more nectar on a calcareous soil than on a clay soil. In the case of buckwheat and heather the reverse is true.

B. J. R.

The Form of Calcium Oxalate Crystals as a Specific Character.—P. JACCARD and A. FREY ("Kristallhabitus und Ausbildungsformen des Calcium-oxalat als Artmerkmal," *Festschrift Hans Schinz, Beiblatt zur Vierteljahrsschrift der Naturf. Gesellschaft, Zürich*, 1928, 15, 127–61, 12 figs., 1 pl.). The formation of calcium oxalate crystals in the bulb-scale epidermis of the genus *Allium* varies from species to species, and is classified into ten types. The following crystal forms are found: (a) various forms of the trihydrate type (*A. Cepa*, etc.); (b) special groupings of the trihydrate type (*A. sphaerocephalum*); (c) the monohydrate type with a feeble power of crystallisation; (d) exclusively monohydrate in the form of crystal sand (*A. globosum*); and (e) absence of crystals (*A. victorale*). The occurrence of these different types appears to be related to the special ecology of the several species rather than to their systematic position, as the monohydrate form is found in the mesophilous and hygrophilous species. The type of crystal is true to the species, being the same in individuals from different localities, of different ages and different degrees of desiccation.

B. J. R.

CRYPTOGAMS.

Pteridophyta.

Megaspores of Selaginella.—H. DUERDEN ("Variation in Megaspore Number in Selaginella," *Ann. Bot.*, 1929, 43, 451–7, 4 figs.). During an examination of the strobili of 33 species of *Selaginella* many variations from the normal number of four megaspores in the sporangium were observed. An increase in megaspore numbers was seen in *S. Willdenowii*, *S. inaequalifolia* var. *perelegans*, *S. Lobbii*, *S. Watsoniana*, *S. serpens*. Reduction in megaspore number below four was noted in *S. Willdenowii*, *S. inaequalifolia* var. *perelegans*, *S. erythropus*, *S. Bakeriana*, *S. stenophylla*, *S. chrysorrhizos*. Inequality in size of spores was observed in 17 species. The remaining species showed four megaspores of equal size, except *S. Bakeriana*, in which the number of megaspores was three.

A. G.

Plagiogyria.—EDWIN BINGHAM COPELAND ("The Fern Genus *Plagiogyria*," *Philippine Journ. Sci.*, 1929, 38, 377-417, 15 pls.). The author revises the genus *Plagiogyria*, and discusses at some length its phylogeny, its peculiarities, and its systematic position. He regards China as the original home of the genus. The number of Oriental species which he maintains is 23, and there are 9 American species. Each species is described and discussed, and several of them are figured. Twelve of them are new to science. A. G.

Schizaea rupestris.—DORR RAYMOND BARTOO ("Origin and Development of Tissues in Roots of *Schizaea rupestris*," *Bot. Gaz.*, 1929, 87, 642-52, 12 figs.). Material of this fern from New South Wales was studied in order to determine the origin and development of the tissues of the root. It was found that all the root tissues have their origin in a pyramidal apical cell. The root structure is probably the simplest of all observed roots. The tissues are differentiated very early, the initials of epidermis, cortex, endodermis and pericycle are only one cell removed from the apical cell. The inner cortical layer and endodermis have a common origin, both being cortical. The pericycle and desmogen have a common origin, both being stelar. The arrangement of the bundle is diarch, consisting of 4 or 6 xylem cells, and from 8 to 12 phloem cells. Thickening of the inner and radial walls of the sclerotic layer is a striking feature. Root hairs take origin very near to the apical region, and they persist as long as the root. The author finds that histological distinction is unreliable as a guide to adult tissues. A. G.

Geotropism of Asplenium and Osmunda.—T. L. PRANKERD ("Studies in the Geotropism of Pteridophyta. IV. On Specificity in Gravitperception," *J. Linn. Soc. (Bot.)*, 1929, 48, 317-36, 2 pls.). An account of the results of 2,300 experiments on seven species of the genera *Asplenium* and *Osmunda*, giving the quantitative reaction to gravity of the fronds at stages previously defined as infant, adolescent, and mature. Specific differences in the presentation time (the unit of measurement of irritability) are slight as compared with generic differences, which are measured in hours for *Asplenium* and minutes for *Osmunda*. *O. cinnamomea* is the most sensitive plant to the force of gravity as yet discovered, its fronds responding to a stimulus lasting only 20 seconds. The latent time also shows little specific, but much generic, difference. *Osmunda* responds three times as quickly as *Asplenium*. By latent time is meant the period elapsing between the beginning of stimulation and the first response. The author gives tables showing the presentation time and latent time for ferns by physiological graphs here termed "graviscritps," and makes generalisations concerning them. Latent time appears in general to be a far more constant quantity than presentation time. It is at its minimum in a fern frond, and is nearly constant throughout the adolescent stages. The suggestion is made that in case of plants of doubtful affinity, when morphological characters are inconclusive, it may be found that physiological data afford criteria of value for indicating affinities. A. G.

Spanish Ferns.—RUIZ DE AZÚA ("Contribución al estudio de las Euflicineas y Euequisetineas españolas, especialmente de las provincias Vascongadas," *Trab. del Mus. Nac. de Cienc. Nat. de Madrid, ser. Botan.*, 1928, 24, 1-116, 63 figs.). A doctoral thesis, divided into six chapters: (1) a historical review of the Spanish pteridophytes from pre-Linnæan times to the present, with the nomenclature in use at different times; (2) development of the Euflicineæ as observed in several selected types; (3) anatomical study of *Cheilanthes hispanica* and *Phyllitis Scolopendrium*; (4) classification of the Euflicineæ—15 genera, 90 species, with synonymy, distribution records and some critical notes; (5) classification of

the Equisetines—7 species, with synonymy and distribution; (6) bibliography of 242 works. A. G.

- **Ferns from New Caledonia.**—EDWIN BINGHAM COPELAND ("Pteridophyta Novæ Caledoniæ," *Univ. Calif. Publ. Bot.*, 1929, 14, 353-69). A revision of the herbarium of New Caledonian ferns acquired from the executors of the late E. Bonati and housed in the Los Angeles Botanic Garden. It contains two large collections made by Franc in New Caledonia, mostly determined by Christ, and other collections. Unfortunately the herbarium was found to have been left in indescribable confusion, and often names and numbers are quite untrustworthy. The author of the above paper has endeavoured to clear up some of the difficulties by a series of nearly 40 critical notes, among which there are descriptions of 13 new species. A. G.

Ferns from Sumatra.—EDWIN BINGHAM COPELAND ("New Pteridophytes of Sumatra," *Univ. Calif. Publ. Bot.*, 1929, 14, 371-8, 7 pls.). Descriptions of 12 new species of ferns collected on the east coast of Sumatra by H. H. Bartlett and a native collector. Among other new records for the island are mentioned *Trichomanes hispidulum*, *Brainea insignis*—which appears at high altitudes after jungle fires—and *Dryopteris Teuscheri*. A. G.

Bryophyta.

Hybrids of Riccardia.—AMOS M. SHOWALTER ("Studies in the Cytology of the Anacrogynæ. V. Hybrid Fertilisation in *Riccardia pinguis*," *La Cellule, Lierre*, 1928, 38, 293-350, 5 pls., 29 figs.). A discussion of hybrid fertilisation in *Riccardia*, including the dehiscence of the archegone and entrance of the antherozoids; entrance of the antherozoid into the egg; condensation of the chromatin of the female nucleus; fusion of gametic nuclei; early embryogeny; nucleolar relationships; fertilisation by antherozoids of type D; theoretical considerations. The author finds that the movements of the antherozoids of *Riccardia pinguis* are not controlled by the disintegration products of the archegonial canal cells. The antherozoids of each of three varieties (A, B, C) are attracted to the eggs of their own or the other types with equal readiness, and fertilise the eggs. Crosses between A and C develop normally and attain maturity. In crosses of type B with A or C the nuclear behaviour is often very abnormal, and development is arrested. Some of the hybrid embryos are aberrant in form. Attempts to cross type D with A or B failed. The salient features of the behaviour of the various homo- and heterozygotes are summarised diagrammatically in parallel columns in a coloured plate. A. G.

Lejeunea in Belgium.—FR. VERDOORN ("Les Lejeunéacées de la Belgique et du Luxembourg," *Rev. Bryol.*, 1929, N.S., 2, 41-3). An account of the species of Lejeuneaceæ found in Belgium and Luxembourg, some of which are of great interest owing to their affinity with tropical species of South America. The same species are found in Ireland, and appear to be relicts of a warmer climate in the past history of the world. An example is *Aphanolejeunea microscopica*, found associated with *Hymenophyllum tunbridgense* in Luxembourg in 1893. A. G.

Lunularia cruciata.—G. NICOLAS ("Observations sur un endophyte de *Lunularia cruciata* (L.) Dumortier," *Rev. Bryol.*, 1929, N.S., 2, 35-40). The author discusses the relation between a colony of *Lunularia*, growing in a laboratory courtyard at Toulouse, and a pezizoid fungus, *Humaria Nicolai*, which, year after year, forms its fructifications amid the patch of *Lunularia*. It would seem that the

fungus grows saprophytically on the dead debris of the hepatic, but also apparently it invades the hepatic and lives endophytically in the tissues of the hepatic in a symbiotic way. The *Lunularia* grows in the courtyard in three states: (1) sterile, very abundant; (2) male, in the shaded, moist parts; (3) female, in the drier, well-illuminated parts. The antheridia are mature in February and March; the sporogonia ripen from July to September. It is the male plants that are invaded by the endophyte.

A. G.

Mosses of Normandy.—R. POTIER DE LA VARDE ("Additions à la flore bryologique de Normandie," *Rev. Bryol.*, 1929, N.S., 2, 30-4). This paper is divided into two chapters: (1) on two Ephemeroaceous mosses new for the Department of La Manche, namely, *Nanomitrium tenerum* and *Ephemerum sessile*. The ecology of these plants is discussed and lists are given of the various bryophytes with which each is associated. (2) A list of records of new localities in which some 13 bryophytes have been discovered in Normandy, for example, *Fissidens Julianus*.

A. G.

Asiatic Mosses.—V. F. BROTHERUS ("Musci novi asiatici," *Rev. Bryol.*, 1929, N.S., 2, 1-16, 1 pl.). A posthumous paper containing descriptions of 33 new species of mosses from various parts of Asia—Siberia (8), Turkestan (4), Mongolia (2), Manchuria (2), China (1), Japan (8), Formosa (8). An important novelty from Japan is the new genus *Sasaokaea*, perhaps allied to *Neckera*, but differing in the form and structure of the leaves; these are figured.

A. G.

Cambodian Mosses.—I. THÉRIOT ("Une poignée de mousses cambodgiennes," *Rev. Bryol.*, 1929, N.S., 2, 17-20, 3 figs.). A small collection of nine mosses sent from Cambodia by A. Poilane, and containing three species new to science and another of great rarity. The novelties are described and figured. Cambodia is a country which has been little explored for mosses.

A. G.

Japanese Hepaticæ.—YOSHIWO HORIKAWA ("Studies on the Hepaticæ of Japan—II," *Sci. Reports, Tôhoku Imp. Univ., 4th Series (Biology)*, 4, no. 2, Sendai, 1929, 395-492, 3 pls., 15 figs.). Descriptions and figures of species of the following genera:—*Fimbriaria conocephalus* (2), *Lunularia*, *Chomiocarpon*, *Blasia*, *Cavicularia*, *Calobryum*, *Ptilidium*, *Lopholejeunea* (2), *Notothylas*, *Anthoceros*. Four of the species are new to science. The relationship and differences of *Blasia* and *Cavicularia* are discussed at some length.

A. G.

Critical Mosses.—H. N. DIXON ("Critical Mosses," *Rev. Bryol.*, 1929, N.S., 2, 21-9). A list of over 40 mosses about which Mons. Naveau had made enquiry in *Rev. Bryol.*, N.S., 1, 38-40. Critical notes are now supplied by the present author, casting light upon the place of publication (if any) of these problems, their synonymy, affinities, etc. Two new species of *Rhapidostegium* from Australia are described.

A. G.

Thallophyta.

Algæ.

New Jersey Dinoflagellates.—G. W. MARTIN ("Three New Dinoflagellates from New Jersey," *Bot. Gaz.*, 1929, 87, 556-8, 12 text-figs.). Descriptions and figures of three new species occurring in brackish waters. One of these, *Prorocentrum triangulatum*, is of great importance in connection with the food of oysters. *Amphidinium fusiforme* is probably of great importance, and *Polykrikos borne-gatensis* is a rare member of a curious and little-known genus.

A. G.

Diatoms.—FREDERICK BEATSON TAYLOR ("Notes on Diatoms. An Introduction to the Study of the Diatomaceæ," Bournemouth, 1929, published by the author, 2a, Montague Road, Bournemouth, 8vo, iv, 1-269; 5 pls. with descriptions and index of 128 figs., and 1 p. of errata, in pocket at end). A book of reference for the use of students of diatoms. It is arranged under the following headings:—What are diatoms?—The discovery of diatoms—Where diatoms are found—Manner of growth—Structure and markings—Movement of diatoms—The geological age of diatoms—The uses of diatoms—Reproduction—Classification—Species of diatoms—The literature of diatoms—The study of diatoms—Collecting diatoms—Nomenclature of diatoms—List of the genera of diatoms—Appendix of references to authorities cited in the various chapters. The alphabetical list of genera gives concisely the author of each genus, the date of publication, the habitat, the position in the classified list, with references to other sections of the present work, and to De Toni's *Sylloge Algarum*, Schmidt's *Atlas*, and other descriptive works. A. G.

Manchurian Diatoms.—B. W. SKVORTZOW ("Marine Diatoms from Dairen, South Manchuria," *Philippine Journ. Sci.*, 1929, 38, 419-30, 2 pls.). A list of 71 diatoms from the northern part of the Yellow Sea, the result of an examination of some samples collected from oysters at Dairen by A. Prosowsky. Twenty-one genera are comprised, and the novelties are three species and twelve varieties and forms. A. G.

Encrusting Algæ.—F. E. FRITSCH ("The Encrusting Algal Communities of Certain Fast-flowing Streams," *New Phytologist*, 1929, 28, 165-96, 1 pl., 10 figs.). An account of the encrusting algæ found on pebbles submerged in fast-flowing streams between Lynton and Ilfracombe, on the north coast of Devonshire. They are summarised as follows:—(1) *Hildenbrandia rivularis* in community with *Lithoderma fluviatile*; (2) the *Chamæsiophon* community, including *Chamæsiophonopsis regularis* (a new genus and species), two new species of *Chamæsiophon* and another one of older date, one new species each of *Pseudoncobyrsa* and *Chroococcopsis*, two species of *Oncobyrsa*, one new species each of *Xenococcus* and *Gongrosira*; (3) the *Phormidium* community. A chapter of concluding remarks is followed by Latin descriptions of all the novelties. A. G.

Key to Oedogonium.—L. H. TIFFANY ("A Key to the Species, Varieties and Forms of the Algal genus *Oedogonium*," *Ohio Journ. Sci.*, 1929, 29, 62-80). This key is the outcome of several years of study of *Oedogonium*, during the preparation of a monograph of the genus, soon to be published. Descriptive notes on new forms and combinations are added, together with a complete list of 344 species, varieties and forms, which are regarded as having a tenable position in the genus. The meaning of species, variety and form is briefly discussed. A. G.

Microdictyon.—WILLIAM ALBERT SETCHELL ("The genus *Microdictyon*," *Univ. Calif. Publ. Bot.*, 1929, 14, 453-588, 105 figs.). A revision of the difficult algal genus *Microdictyon* and of its species, which have been so hopelessly confused in the past. The revision is founded on typical or authentic specimens, and includes much new material. A historic survey of the genus is given, and a system of classification is adopted which divides the 19 species into three groups, distinguished by the mode of attachment of the branch-tips in building up the reticulation of the frond; these are called *Annuliferæ* (14 species), *Fibuliferæ* (4 species), *Tenaculiferæ* (1 species). Further divisions into sections—*Eumicrodictyon*, *Calodictyon*, etc.—are founded on the modes of ramification of the filaments, and further important characters are the prominence and disposition of the primary filaments in the

fronds, the relative diameters and lengths of the segment cells, the shape and size of mesh, the colour, and the character of the cell walls. Thus the species are fitted into a clavis, and their essential characteristics are well figured. A. G.

Nitella flexilis.—P. A. DAVIES ("Irreversible Injury and CO_2 Production from Cells of *Nitella flexilis*," *Bot. Gaz.*, 1929, **87**, 660–4). A study of the production of carbonic acid from irreversibly injured cells of *Nitella flexilis*. The method of experiment and the precautions taken are described. The conclusion drawn from the results is that the rate of production of CO_2 falls below the normal at the time of, or very shortly after, the occurrence of injury that is irreversible. This result is at variance with the findings of A. R. C. Haas in case of *Laminaria* tissue—that the rate of CO_2 production was increased for an extended period after the cells were dead. A. G.

Ectocarpus siliculosus.—MARGERY KNIGHT ("Studies in the Ectocarpaceæ. II. The Life-history and Cytology of *Ectocarpus siliculosus*," *Trans. Roy. Soc., Edinburgh*, 1929, **56**, 307–32, 6 pls., 3 figs.). The life-history of *Ectocarpus siliculosus* in British waters is described and is contrasted with the behaviour of the same alga in the Mediterranean. In British waters the plant body is normally diploid, and produces diploid zooids in plurilocular sporangia; these zooids germinate directly into diploid plants. Alternatively the diploid plant may bear unilocular sporangia which produce haploid gametes, which unite in pairs, and from the zygote arises a diploid plant once more. But in the Mediterranean the life-history of *E. siliculosus* is strikingly different; the zooids from plurilocular sporangia are undoubtedly haploid gametes, and no unilocular sporangia are produced. The chromosome number in the British plants is 16, whereas in Naples plants the number is 8. The whole subject is discussed in detail under the headings—general morphology, plurilocular sporangium, unilocular sporangium, cytology, function and fate of the zooids, life-histories of *E. siliculosus* in British waters and in the Mediterranean Sea, geographical distribution of haploid and diploid thalli, alternation of generations, sexuality and anisogamy. A. G.

Spanish Algæ.—PEDRO GONZÁLEZ GUERRERO ("Contribución al estudio de las algas y esquizofitas de España," *Trab. del Mus. Nac. Cienc. Nat. Madrid, ser. Botan.*, 1927, **22**, 1–52). The author gives a classified list of 120 freshwater algæ collected mostly in the neighbourhood of Madrid, and shows that fully 50 of them are new records for the flora of Spain. In another chapter he adds a list of 43 blue-green algæ, 24 of which are new records for Spain. A bibliography of about 150 papers is appended. A. G.

Algæ of Guadalajara.—SERGIO CABALLERO Y VILLALDEA ("Datos para la flora algológica de la provincia de Guadalajara—I. parte," *Bolet. R. Soc. española Hist. nat.*, 1929, **29**, 217–25). The first instalment of a list of the freshwater algæ of the province of Guadalajara, which the author has explored very closely. The present contribution contains 75 species of Cyanophyceæ, with field notes. A. G.

Algæ of Zürich.—EDWIN MESSIKOMMER ("Beiträge zur Kenntnis der Algenflora des Kantons Zürich. IV. Folge: Die Algenvegetation der Moore am Pfäffikersee," *Vierteljahrsschrift der Naturforsch. Gesellschaft in Zürich*, 1929, **74**, 139–63, 1 pl.). The author describes the 17 collecting grounds examined, and gives a list of about 450 freshwater algæ collected. The novelties are among the desmids—one species, six varieties, and four forms. These and some critical species are discussed in detail and figured. A. G.

Florida Algæ.—WM. RANDOLPH TAYLOR ("Notes on the Marine Algæ of Florida," *Bull. Torr. Bot. Club*, 1929, **56**, 199–210). The author published in 1928 his report on the Marine Algæ of Florida, with special reference to the Dry Tortugas (Carnegie Institute Publication no. 379), in which were included nearly all the species that could be confidently accepted. The study of a further large collection of West Indian and Brazilian material has brought to light some more species which had been recorded for Florida by previous authors. Eighteen are thus added definitely to the list of Florida algæ, raising the total to 478, and 28 names more are also submitted by the author as possible but insufficiently authenticated algæ of the Florida coast. Allusion is made to the Guadeloupe algæ as represented in the catalogue of Mazé & Schramm, a list which involves so many obsolete names, nomina nuda and erroneous determinations, that it needs a thorough revision. As compared with the 420 well-determined algæ of Florida, the Guadeloupe algæ can be considered to include about 250 of these species, with a residue of about 290 names which call for investigation. A. G.

Economic Aspects of Algæ.—L. H. TIFFANY ("Some Economic Aspects of the Algæ," *School Science and Mathematics, Chicago*, 1928, **28**, 581–93, 4 figs.). The author gives an introduction in which he discusses the classification of algæ and their periodicity. He then considers the economic aspects of the group—*detrimental*, on the one hand, e.g., in rendering water undrinkable; *beneficial*, on the other hand, in providing a source of potash and iodine, in forming travertine, in serving as a fertiliser for farms, in clothing bare rocks, in supplying constituents for the soil, in having a direct use as human food in some parts of the world, and an indirect use through feeding crustaceans which are consumed by fish. A. G.

Fungi.

Study of Phytophthora.—S. F. ASHBY ("Further Note on the Production of Sexual Organs in Paired Cultures of Species and Strains of *Phytophthora*," *Trans. Brit. Mycol. Soc.*, 1929, **14**, 254–60, 2 text-figs.). The author gives results of his cultures and observations of a number of *Phytophthora* species. As a rule, sexual organs were not formed readily either in single cultures or in paired cultures—in the latter case between different individuals or different species. For instance, *P. Arecæ* did not develop oospores on any kind of medium, nor did united strains of *P. Meadii* (from *Hevea brasiliensis*); but when these were grown together, sexual organs developed freely in four to five days. Sexual organs were also developed in *P. Richardiæ* (from Calla lily), and more freely when paired with *P. Cinnamomi*. Transference to water induced the development of zoosporangia in *P. Cinnamomi* and in *P. cambivora*. A. L. S.

Sexual Organs in Phytophthora.—S. F. ASHBY ("The Production of Sexual Organs in Pure Cultures of *Phytophthora Cinnamomi* Rands and *Blepharospora cambivora* Petri," *Tom. cit.*, 260–3, 2 text-figs.). Ashby supplements the previous paper on *Phytophthora* sexual organs by the statement that these have been found in a pure culture of *P. Cinnamomi* and in a culture of that species paired with *Blepharospora cambivora*. In the single culture of the former were found many mature sexual organs with large amphigynous antheridia and oogonia. These organs appeared to be borne on separate hyphæ; the oogonia were yellow and broadly clavate. Ashby suggests a close relationship between the two fungi experimented with. A. L. S.

Bulgaria Fungi.—S. KILLERMAN-REGENSBURG ("Die Bulgaria Fr. Gruppe," *Hedwigia*, 1929, 69, 84–93, 1 pl.). The author describes the group as uniting the characters of cup-fungi (Pezizaceæ) and gelatinous fungi (Tremellaceæ). He includes in the group the genera *Coryne*, *Bulgaria*, *Burkardia*, *Bulgariella*, *Bulgariopsis* and *Neobulgaria*. Diagnoses of the different genera are given and the habitat of the species. A further instalment of the paper is promised. A. L. S.

Giant Ascospores.—B. O. DODGE ("The Nature of Giant Spores and Segregation of Sex Factors in Neurospora," *Mycologia*, 1929, 21, 222–31, 3 text-figs.). These spores are multinucleate and are not homothallic, as, when cultures were made, no perithecia were formed. This may be due to the nuclei of the spore all belonging to one sex and lodged at the end of the ascus. The author discusses sex segregation in ascospores from every point of view. The problems of sex in differently placed ascospores have not yet been solved, but much work is being carried on by means of spore cultures. A. L. S.

Study of Discomycetes.—E. J. H. CORNER ("Studies in the Morphology of Discomycetes. I. The Marginal Growth of Apothecia. II. The Structure and Development of the Ascocarp," *Trans. Brit. Mycol. Soc.*, 1929, 14, 263–91, 11 text-figs.). The author has been mainly concerned with the continued development of the sterile tissue of the apothecial margin. He has selected *Galactinia saniosa*, *Peziza aurantia*, and *Coprobria granulata* as typical forms. He finds that the tissue surrounding the fruiting body consists of two palisade layers, the cortex and hymenium, with a medulla of interwoven hyphæ. He has followed the growth of these layers, and finds that the middle region, between cortex and hymenium, is where new hyphæ are produced. In time their apical growth is arrested, and their place is taken by laterals, which grow for a time and are in turn replaced by others. The outside hyphæ become cortical hyphæ; those on the inside form paraphyses. These latter are specialised mucilage hyphæ, which are commonly pigmented; the cortical hyphæ are non-mucilaginous, and form a pseudoparenchyma which supports the hymenium. A further series of genera and species were examined, including stipitate species such as *Helvellæ*, and the function of the different hyphal systems in these is described. A. L. S.

Ramularia on Ranunculus.—CH. KILLIAN ("Développement et biologie du *Ramularia repentis* Oud.," *Bull. Soc. Mycol., France*, 1929, 45, 145–52, 2 pls.). The fungus grows on the leaves of *Ranunculus repens*, forming on the upper surface reddish spots which rapidly become brown. On the lower surface conidiophores and conidia of *Ramularia* are formed. At a later stage the mycelium forms a stroma, on which are developed pycnidia. Later, on the same stroma, appears an ascomycete which had already been noted and determined as *Fabræa Ranunculacearum* Fries. Owing to Killian's observations and cultures, these various stages have been linked up and united under *Fabræa*. Other species of *Ramularia* have been diagnosed on various species of *Ranunculus*, but the mature stages are very seldom developed. The parasite was successfully inoculated on *Ranunculus acer*, but not on *R. bulbosus*. A. L. S.

Secondary Fungi of Rust Cankers.—WALTER H. SNELL ("Dasyscypha *Agassizii* on *Pinus Strobus*," *Mycologia*, 1929, 21, 235–42, 1 pl.). The favourite habitat of the species is the rust-cankered bark of *Abies balsamea*, though it occurs also on bark not affected by the rust (*Cronartium ribicola*). The writer gives an account of its occurrence and describes the fungus, especially the distinctive microscopic characters. A. L. S.

Taxonomy of *Peziza quernea*.—W. H. DIEHL and EDITH K. CASH (*Mycologia*, 1929, 21, 243–7, 2 text-figs.). The fungus in question has in recent years been classified as a *Cenangium*. The writers place it in a new genus, *Godroniopsis*, differing from *Cenangium* “in the presence of an epithecium and of claw-like excipular ridges on the margin of the open disk.” The specimen described was from Florida. A. L. S.

Fungus on Liverwort.—E. J. H. CORNER (“A Humariaceous Fungus Parasitic on a Liverwort,” *Ann. Bot.*, 1929, 43, 491–505, 6 text-figs.). The fungus was found by the writer on the Liverwort, *Plagiochila asplenoides*, and only in one part of a beech wood in the Chilterns. It had been already discovered in France, and described by Grelet as *Neotiella Crozalsiana*. It is a minute ascomycete, the apothecia of which never open completely. It lives on the thallus of the liverwort, but only causes the destruction of a few cells. Corner has made a study of the anatomy, and has traced the development of the fruiting body and of the spores. He has also discussed at length the systematic position, finally concluding that it belongs to a series of humariaceous operculeæ, and is characterised by the presence of carotin in the paraphyses. The restricted development of the apothecium may be due to depauperation and xerophily. The development of guttæ in the spores is also discussed. A. L. S.

Study of Aspergillaceæ.—ADALBERT BLOCHWITZ (“Die Aspergillaceen System und Phylogenie,” *Ann. Mycol.*, 1929, 27, 185–204, 1 pl.). Under this family Blochwitz includes three genera, *Aspergillus*, *Citromyces* and *Penicillium*. They are distinguished by differences in the stalk, the conidia-bearing apex, and the sterigmata. These characters are outlined, and reasons for choice of characters as systematic are given as indicating the phylogeny within the family. As to the perfect fructification, he finds perithecia are developed only in three species of “Euglobosæ”—that is, species with rounded apical swelling. In other species sclerotia are formed. He has not found perithecia in *Penicillium*, but they are very rare, and generally only sclerotia are developed. The spore colours are also described; these vary considerably from species to species, more especially in the genus *Aspergillus*, in which the colour may also spread to sterigmata, stalk, and even to the sclerotium. A. L. S.

Study of *Aspergillus*.—ADALBERT BLOCHWITZ (“Die Gattung *Aspergillus*. Neue spezieis. Diagnosen. Synonyme,” *Ann. Mycol.*, 1929, 27, 205–40, 1 pl., 13 text-figs.). Blochwitz first describes his new species, with their affinities also indicated. He then gives his views as to the characters that should weigh most in diagnosis: colour is of value, with size and form of spores. It is of supreme importance that the early stages of growth should be diagnosed and compared. The finding of perithecia or sclerotia cannot be considered as good specific characters, as they are rare, and frequently are produced only in very special growth conditions. The form of the apical swelling is distinctive, and the species are ranked by him, according to the form of the apex, as *Euglobosæ*, *Subglobosæ* and *Aglobosæ*. The species are described under these groups. A key gives assistance in determination. A long list of synonyms is given, and a list of literature dealing with the subject. A. L. S.

Study of Ascomycetes.—CARROLL W. DODGE (“The Higher Plectascales,” *Ann. Mycol.*, 1929, 27, 145–84, 2 pls., 2 text-figs.). The Plectascales are characterised by scattered asci surrounded by a somewhat loose peridium and without an ostiole. Dodge traces their relation to the Tuberales. He then gives an account of the various families that he places in the order: *Onygenaceæ*, *Trichocomaceæ*,

and Elaphomycetaceæ. These are all described, with their genera and species. The two first families are monotypic—*Onygena* a fairly common and widely distributed form, and *Trichocoma* very rare. Under Elaphomycetaceæ are included two genera—*Mesophellia* and *Elaphomyces*, the latter with 15 species, many of them of wide distribution. With each species is given a full account of form, size, etc., with abundant microscopical details as to internal characters. They are generally found in woods beneath the soil. A good index of names and synonyms is provided.

A. L. S.

Study of Yeasts.—J. BEAUVERIE ("Sur un Zygosaccharomyces de la datte iso-hétérogame," *Bull. Soc. Mycol., France*, 1929, 45, 153-70, 16 text-figs.). The yeast was obtained from the surface of a date fruit (*Phoenix dactylifera*) and was cultivated on various substances—malt, carrot, tomato, etc. The results of these cultures are described, and the effect on the fermentative activity of different temperatures—a high temperature giving the best results. Beauverie gives an account of the sporulation of the yeast, of the nature of the cells and their contents, and of certain granulations and lines demonstrated by staining that might be chondriomes. The most notable character was the frequency of conjugation, both isogamic and heterogamic, with the formation of asci and spores. Finally he discusses the systematic position of the yeast, and places it in *Zygosaccharomyces Cavaræ* Rodio, with which it agrees in all the important characters, but with certain divergencies that indicate a varietal status (var. *Beauverie*).

A. L. S.

Fungus Causing Grape Disease.—C. L. SHEAR ("The Life-History of *Sphaceloma Ampelinum* de Bary," *Phytopathology*, 1929, 19, 673-9, 5 text-figs.). This disease, usually called anthracnose, causes great loss to vine-growers. The fungus causing the disease has been generally observed in the imperfect stages, and has not been authentically related with the perfect fruiting bodies. By prolonged cultures Shear has secured the final growth stages, and has identified it with a genus, *Plectodiscella*, now transferred to *Elsinoe*, an older name. The fungus, in its mature stage, forms a stroma in which the asci and spores are embedded.

A. L. S.

Fungus Endophytic in Hepatic.—G. NICOLAS ("Observations sur un endophyte de *Lunularia cruciata* (L.) Dumortier. Ses relations avec une Pézize, *Humaria Nicolai* R. Maire," *Rev. Bryol.*, 1929, 2, 35-40, 1 text-fig.). Several instances have been recorded of the invasion of the hepatic thallus by fungi in the mycelial condition. In the present case the association seems to be accidental, indicating neither parasitism nor symbiosis. Descriptions of the mycelial invasion are given, and the subject is discussed in all its bearings. A pezizoid fungus was developed, and has been determined by René Maire as *Humaria Nicolai* n. sp.

A. L. S.

Ascochyta Gossypii.—H. G. CHIPPENDALE ("The Development in Culture of *Ascochyta Gossypii* Syd.," *Trans. Brit. Mycol. Soc.*, 1929, 14, 201-15, 23 text-figs.). *Ascochyta Gossypii* is a parasite of the cultivated cotton plant, and was first collected at Kashmir by Dr. E. J. Butler. It has caused a serious outbreak of disease in Arkansas and other States in America. The author has cultivated it on artificial media, and so has been able to follow the life-history. After development of the mycelium (in 36 hours) pycnidia are formed and chlamydospores on the mycelium—brown muriform bodies—which the writer has termed hypnocysts. Attention was given to the form and development of the pycnidium. It was found that very little nourishment was required; it was indifferent to light, though sensitive to temperature, and aeration was necessary; excess of carbon dioxide was inimical to pycnidial formation.

A. L. S.

Uropyxis.—HERMANN POEVERLEIN ("Uropyxis, eine für Europa neue Uredineen-Gattung," *Ann. Mycol.*, 1929, 27, 241-2). *Uropyxis* was founded by Schroeter in 1875, to include species with 1-septate teleutospores. Seventeen species of the genus have been determined, chiefly in America. In 1928 Prof. Dietel collected in Germany *Uropyxis mirabilissima* from the leaves of *Mahonia aquifolium*. The species has been found again, and it is suggested that it may be widely distributed. A. L. S.

American Uredineæ.—W. R. HUNT ("Collections of Rusts made in New York State," *Mycologia*, 1929, 21, 288-91). The writer gives the results of his collections of rusts during three months. A total of 97 collections resulted in 9 genera and 42 species, a number of them not hitherto recorded in the State. A. L. S.

Effect of Weather on Stem Rust.—EDMUND B. LAMBERT ("The Relation of Weather to the Development of Stem Rust in the Mississippi Valley," *Phytopathology*, 1929, 19, 1-71, 11 text-figs.). The author gives an account of all the weather conditions that might presumably influence the growth of the rust fungus in the Mississippi Valley. There is no evidence that the uredineal stage survives the winter in that region. Infection is carried by the barberries. The teleutospores germinate in April, and later in the month the pycnidia form on the barberries until early in May; the rust then spreads to the grasses in the last weeks of May. The viability of the spores and the influences that affect their germination were examined. It was found that teleutospores lose their viability if kept for several months at a high temperature; they were not affected by alternate freezing and thawing or wetting and drying. It was found also that teleutospores varied a great deal in the lengths of time for germination, an advantage to the fungus in prolonging the time of possible infection of the barberries. In nature, viability was lost in a few months, but in cold storage not for nearly a year. Over-wintering of uredospores generally is limited to seasons and regions where temperature and rainfall favour the growth of uredinia at frequent intervals during the winter. When rust becomes plentiful throughout one or more fields of grain, the infection may spread for several miles. There is evidence that rust may be blown several hundred miles from a severely infected area. No evidence was obtained of any specific meteorological condition or sets of conditions accompanying epidemics of rust. The development of epidemics on oats in years when stem rust is scarce on wheat is also a puzzling circumstance. The predominance of different physiologic forms of the rust adds a further complexity. Indeed, so many factors are involved that each epidemic appears to be a law unto itself, and coincidences must not be taken for causal relations. A full list of papers on the subject is given. A. L. S.

Study of Cronartium.—W. G. HUTCHINSON ("Studies on the Mycelium of *Cronartium Comptoniae* Arthur on *Pinus sylvestris* L.," *Phytopathology*, 1929, 19, 741-3, 4 text-figs.). The study was undertaken to enable observers to detect the presence of the fungus in the tissues of the pine in the absence of the æcidia. An examination of wood invaded by *Cronartium* was carried out by the usual methods of staining, by microscopical examination and by comparison with the mycelium of other rusts. The mycelium of *Cronartium Comptoniae* is characterised by its large size and by the possession of bulged haustoria. It occurs in the parenchyma cells of cortex, phloem and medullary rays, in the sieve tubes and occasionally in the tracheid cells of the xylem. It grows between the cells separating them and penetrating them with its large haustoria. A. L. S.

Rust Control.—E. B. LAMBERT and E. C. STAKMAN ("Sulphur Dusting for the Prevention of Stem Rust on Wheat," *Phytopathology*, 1929, **19**, 631-43). Experiments have proved that under certain conditions the rust disease can be largely checked by the application of sulphur dust. It must, however, be applied at an early stage before the infection has entered the tissues, and the treatment must be renewed constantly.

A. L. S.

Treatment of Disease on Barley.—R. H. PORTER, S. F. YU, and H. K. CHEN ("The Response of Hulless Barley to Seed Treatment for Covered Smut and Stripe Disease," *Phytopathology*, 1929, **19**, 657-66, 5 text-figs.). The plants treated were infected with *Ustilago Hordei* and *Helminthosporium gramineum*. The barley, an important cereal in the lower Yangtse valley, was severely infected by the two fungi. Seed treatment was the most effective in dealing with both types of disease. Either dry "Uspulun" or solutions of copper carbonate were employed, and both were effective, as proved by the yield of grain.

A. L. S.

Study of Septobasidium.—J. N. COUCH ("A Monograph of Septobasidium—Part I. Jamaican Species," *Journ. Elisha Mitchell Sci. Soc.*, 1929, **44**, 242-60, 16 pls.). The genus *Septobasidium* is a resupinate Basidiomycete of tropical countries. It is to be found on the bark or leaves of various trees, and always in association with scale insects, which it covers and parasitises. Couch describes eight species from Jamaica, six of which are new to science; he also describes a new species of the closely related *Helicobasidium*. After prolonged study he has decided that neither parasitism nor saprophytism wholly describe the relations between the fungus and the insect: "The two live together in a symbiotic relationship at the expense of the host plant." In the end the fungus lives largely on the insects, though not utterly destroying them. The association of fungus and insect is described and figured: the fungus enters the tissues of the insect and absorbs food, finally killing the victims, though some survive and reproduce their kind. On the other hand, the fungus provides shelter from inclement weather and from the attack of natural enemies.

A. L. S.

Fungus Cultures.—K. ST. G. CARTWRIGHT ("Notes on Basidiomycetes Grown in Culture," *Trans. Brit. Mycol. Soc.*, 1929, **14**, 300-5, 4 text-figs.). Cartwright's first notes describe growths of *Lenzites sapiaria* on artificial media. That and similar growths were generally abnormal and more primitive in type, though in old cultures the typical form may also occur. The first growth noticed was in general form like a *Sparassis*, the outer surface bearing the hymenium. Another form resembled a coloured *Corticium*—from yellow to brown. A hydroid form also appeared. The second note deals with a culture of *Pholiota adiposa* in which secondary spore formation occurred profusely. Sporophores were also formed; they were unusually small, though otherwise typical.

A. L. S.

Armillaria mellea in a Mine-Working.—E. H. ELLIS (*Tom. cit.*, 305-7, 2 text-figs.). An account is given of a large development of *Armillaria* rhizomorphs. They were found at a point 80 feet below the surface of a hill of gypsum that had been partly dissolved by water. The rhizomorphs filled the fissures. There was no wood near, but six feet away there was an old working, with timbers to which some rhizomorphs were attached. No fruit bodies of *Armillaria* were present.

A. L. S.

Saltation in Diaporthe.—A. S. HORNE and S. N. DAS GUPTA ("Studies in the genera *Cytosporina*, *Phomopsis* and *Diaporthe*. I. On the Occurrence of an

Ever-Saltating Strain in *Diaporthe*," *Ann. Bot.*, 1929, **43**, 417-35, 7 text-figs.). The paper is confined to a study of *Diaporthe perniciosa* and its behaviour in cultures. In certain acid media a particular strain was constantly saltating. Full descriptions are going of the experiments and of the type, occurrence, and continuance of the saltation. A. L. S.

Strawberry Mycorrhiza.—PHILIP R. WHITE ("Mycorrhiza as a Possible Determining Factor in the Distribution of the Strawberry," *Ann. Bot.*, 1929, 535-44, 6 text-figs.). An attempt is made to correlate the distribution of *Fragaria chiloensis* with the presence or absence of suitable Mycorrhiza. The mycorrhizal fungus has been isolated from the roots, and several fungi, among them a *Phoma*, have appeared in the cultures. Synthesis between the fungus and the strawberry has not yet been attempted, but it is thought that the association may explain the difficulty of growing *F. chiloensis*. A. L. S.

Notes on Mutations.—RENÉ VANDENDRIES ("A propos des mutations hétérohomothalliques chez les champignons," *Bull. Soc. Roy. Bot. Belgique*, 1928, **61**, 75-6). The author summarises what is known as to the existence of homothallic and heterothallic stages in fungal growth:—Spores of heterothallic Basidiomycetes are haploid and give rise to sterile monospermous mycelium. By the conjugation of two such mycelia there is originated the diploid fertile stage of growth. But it has now been proved that after a lapse of time—up to the end of 15 weeks—there may be a mutation from the haploid to the diploid condition designated by Vandendries as heterohomothallic mutation. Such a mutation probably explains the formation of perithecia and sclerotia in old cultures of certain *Penicilliums*. Similar mutations from haploid to diploid have been proved also in *Uredineæ*, and probably occur in other groups. A. L. S.

Problems of Sex in *Coprinus*.—RENÉ VANDENDRIES ("Comment résoudre le problème sexuel du *Coprin micacé*," *Bull. Soc. Roy. Bot. Belgique*, 1929, **61**, 123-35). The author discusses at some length the conditions that might influence sexuality in *Coprinus micaceus*. He has seen cause to affirm that, between individuals from the same base, crossing follows the laws of sexual dihybridism; two carpophores from the same mycelium—but at some distance from each other—may present variations due to mutations; between mycelium of neighbouring groups, but some distance apart, fertility is the rule. Other somewhat similar observations were made. He touches on the chemical differences that might influence fertility, but no positive results have been obtained that show any difference between the + and - strains. A. L. S.

Polyporus balsameus, a Root Parasite.—ERNEST E. HUBERT ("A Butt Rot of Balsam Fir caused by *Polyporus balsameus* Pk.," *Phytopathology*, 1929, **19**, 725-32, 3 text-figs.). The fungus was reported some years ago as causing a brown butt rot of the balsam fir. Recently Hubert found it growing on *Thuja occidentalis*, and has now fully described it, as it affects that tree and also *Abies balsamea*. Basal fire scars, wind cracks, pin knots on trunks and injuries to exposed roots, along with resin flow, are evidences of the presence of the fungus. The mycelium penetrates the cells of the wood tissue and corrodes the cell walls, finally rotting the wood, which crushes to a fine powder. The sporophores appear on the tree in late August, and are very abundant, but disappear soon, owing to the attack of grubs and beetles. Wind breakage and windfall follow soon on the death of the tree. Great loss in the forest is caused by the fungus. A. L. S.

Lentinus lepideus as a Tree Parasite.—W. W. WAGENER (" *Lentinus lepideus* Fr.: A Cause of Heart Rot of Living Pines," *Phytopathology*, 1929, 19, 705–12, 1 text-fig.). *Lentinus lepideus* is generally regarded as a saprophyte, but from observations made, Wagener has found that it causes a heart rot of pines, chiefly western yellow pine, *P. ponderosa*, and also other pines, though to a less degree. It is a wound parasite, and thus attacks any damaged part of the tree. The woody tissues are permeated and become decayed and friable. The disease is very prevalent in California. A. L. S.

Polyporus circinatus, a Root Parasite.—ERNEST E. HUBERT ("A Root and Butt Rot of Conifers caused by *Polyporus circinatus* Fr.," *Tom. cit.*, 745–7). Several species of Polyporei cause disease of pines by attacking the roots. *P. circinatus* has been determined by cultures, etc., to be the causal organism of red root rot; it appears as a dark reddish band surrounding the decayed areas. The sporophores, like those of *P. Schweinitzii*, grow on the ground at some distance from the host trees. As regards the method of infection, there are indications that it is a wound parasite, entering the roots through some injured portion and developing in the heart wood. It has been suggested that injury of tree and roots by fire may be correlated with the fungus attacks. A. L. S.

Notes on Amanita.—E. GILBERT ("Notules sur les Amanites," *Bull. Soc. Mycol. France*, 1929, 45, 129–40). The author discusses the systematy of *Amanita baccata* and of allied forms such as *A. Barlae* and *A. Corticelli*. He notes that *A. rubescens* and other *Amanita* in certain conditions may be unrecognisable. He also asserts the edible qualities of *A. pantherina*, which, in any case, is only slightly poisonous. A. L. S.

Use of Iodine in Study of Fungi.—E. GILBERT ("L'emploi des vapeurs d'iode en mycologie," *Tom. cit.*, 141–4). Gilbert finds an iodine stain very effective in enabling the observer to determine the number of spores on the basidium, more especially in the case of lighter-coloured spores. He places in a closed tube some fragments of iodine, allowing them to vaporise. He then introduces a morsel of the hymenium to be examined. In two or three minutes the spores are tinted and may be counted with accuracy. He insists on the value of this method and on the ease with which it is applied. A. L. S.

New Species of Crepidotus.—ALBERT PILAT ("Ueber eine neue interessante Art aus der Gattung Crepidotus Fries," *Hedwigia*, 1929, 69, 137–47, 3 text-figs.). The author describes the characters and affinities of the genus. The new species grew on dead branches of *Alnus incana*. It is characterised by brown lamellæ and has angular warted rust-coloured spores. Pilat has diagnosed it as *C. carpathicus*. Notes are given on species of *Claudopus*. A. L. S.

Congo Fungi.—M. BEELI ("Contribution à l'étude de la flore mycologique du Congo," *Bull. Soc. Roy. Bot. Belgique*, 1928, 61, 78–103, 4 pls.). Beeli presents the Fungi Goossensiani VI, comprising the Agaricaceæ, Rhodosporeæ, Phæosporeæ, Amerosporeæ and Atrosporeæ. The many fungi described are, with very few exceptions, new to science. Diagnoses in Latin are published, along with descriptions in French. Data provided by Madame Goossens are given with each species, and the illustrations are taken from her water-colour drawings of the fungi. A. L. S.

Soil Fungi.—MARJORIE E. SWIFT ("Contributions to a Mycological Flora of Local Soils," *Mycologia*, 1929, 21, 204–21, 4 pls.). Portions of soil from 22 different localities were taken in Illinois. The type of soil ranged from pure sand to woodland

humus, and the samples were taken from various depths. Cultures resulted in the determination of 18 different genera of fungi, 39 species, and 1 variety. In addition, 4 *Actinomyces* and several yeasts were isolated. As to distribution, they were most numerous near the surface, decreasing with the depth to 90 cm. Many of the species had been found in other countries, but eight were reported for the first time, two of these new species—*Chaetomium subterraneum* and *Trichurus terrophilus*. The genera most commonly formed in the soil were similar to those found in other countries in both hemispheres. Lists of the species, with their locality and soil position, are given, with copious notes on the various findings. A. L. S.

Media for Fungus Cultures.—BESSIE E. ETTER ("New Media for Developing Sporophores of Wood-Rot Fungi," *Mycologia*, 1929, 197–203, 2 pls.). The writer comments on the difficulty so often experienced of inducing the full growth of the larger fungi in artificial cultures. She has succeeded with a medium made of corn meal, starch, wood flour and malt liquid. The fungi grew rapidly on this medium and formed perfect sporophores. Her methods of using the media are described, and a list of the successful cultures is given. A. L. S.

Studies of Torulopsidaceæ.—R. CIFERRI and P. REDAELLI (*Ann. Mycol.*, 1929, 27, 243–95, 3 pls.). The authors characterise the paper as "a tentative general systematic classification of the asporigenous ferments." These are grouped under Torulopsidaceæ, and the characters for diagnosis include morphological and morphogenic with cultural examination, biochemical and biological examination and definitive observation, with conservation of the fungous strain on definite substrata, such as carrot broth agar. These fermenting saccharomycetous fungi have been thoroughly studied by the authors, and their results are tabulated under a series of families, genera, and species belonging to the section designated as "medical mycology." A further list of 38 species is given, which have been previously studied, and "fundamental bibliographical references" are added. On the plates are figured many of the fungi as seen in various culture experiments. A. L. S.

Problems of Development in Fungi.—H. C. GWYNNE-VAUGHAN (*Trans. Brit. Mycol. Soc.*, 1928, 4, 193–201). The author has reviewed, in this presidential address, the process of sexual development in the different groups of fungi, contrasting it with development in animals and in green algæ. The sexual process is outlined in Phycomycetes (Oomycetes and Zygomycetes), in Ascomycetes and in Basidiomycetes. Attention is drawn to the special type of heterothallism in Basidiomycetes and Ascomycetes, mainly of a nutritive nature, as the strain may be influenced by change of culture media. But behaviour is very varied, as even when heterothallism is the rule, fruiting bodies may arise from single spore cultures. The contrast as well as the similarity of nuclear behaviour is pointed out between Ascomycetes and Basidiomycetes, where association of nuclei is not followed by fusion till after many cell generations—not till the basidium is formed in Hymenomycetes—and not till the ascus stage of the Ascomycetes. Many problems are stated in the address, and suggestions given as to their solution. A. L. S.

Lactose-Fermenting Yeasts.—M. GRIMES and J. DOHERTY ("A Study of Lactose-Fermenting Yeasts isolated from Milk, Cream and Butter," *Sci. Proc. Roy. Dublin Soc.*, 1929, 19, 261–4). These yeasts that induce the fermentation of milk, cream, etc., are of importance in the making of dairy products. When cream is kept too long before churning, the yeasts give rise to a fermentation that prevents the formation of butter. They are widely distributed, and can develop in substances with a high degree of acidity. Two types of yeast have been experimented

on by the authors—*Torula cremoris* and *T. spherica*. Both caused a production of gas in the milk. The characters of the cells are described and also the various cultures, and the production of gas was estimated. One of the types (A) was found to be similar to *Torula lactosa* isolated from Canadian cheese; the other (B) was identical with *T. cremoris*. Both induced acid and gas in milk, cream, etc.

A. L. S.

American Fungi.—CARLETON REA and J. RAMSBOTTOM ("Some Fungus Forays in America," *Trans. Brit. Mycol. Soc.*, 1929, 14, 293-9). The forays here described were held during the meetings of the Botanical Congress at Ithaca in 1926. The authors observe that though for the most part the larger fungi were familiar European species, they seemed to be different, with a range of variation unknown here. Thus *Amanita muscaria* had an orange cap instead of scarlet as in our own woods. The comparative rarity and abundance of species were different, species common in America being rare here. Microfungi were noted, but the long list given mainly consists of the larger forms, and almost all of them Basidiomycetes. Only a few Ascomycetes are recorded, including *Endothia parasitica*, which was working havoc on chestnut trees.

A. L. S.

Mycological Notes.—L. O. OVERHOLTS (*Mycologia*, 1929, 21, 274-87, 3 pls.). The species dealt with are mostly Basidiomycetes. The writer has considerably enlarged the published descriptions from his observations in the field and in the laboratory. Two new species are described, *Corticium Pruni* and *Hypochnus pennsylvanicus*.

A. L. S.

Fungus Collecting in France.—EUG. MAYOR ("Herborisations mycologiques dans la région de Chamonix," *Bull. Soc. Mycol. France*, 1929, 171-83). Mayor notes that the mycology of the French Alps has received but little attention. A visit of a few days enabled him to make a special study of the district, more especially of parasitic species. He succeeded in collecting and determining 102 different parasitic fungi, some of them growing on different host plants. The Uredineæ bulk most largely in the list, and there are a considerable number of mildews recorded (Erysiphaceæ).

A. L. S.

Oxford Foray.—E. M. WAKEFIELD (*Trans. Brit. Mycol. Soc.*, 1929, 14, 181-3). The foray was held by members of the Mycological Society in the spring of 1928. Owing to previous dry cold weather, large collections were not made, but a very varied series of forms—mainly microfungi—was obtained. A list of the species, with each locality, is given.

A. L. S.

New Species of *Oidium*.—A. CHASTON CHAPMAN (*Trans. Brit. Mycol. Soc.*, 1929, 14, 291-3, 1 pl.). The new fungus was found in a sewer connecting a factory with the main town sewer. It developed so fast that it blocked the sewer. The growth consisted of a dark brown gelatinous mass of a leathery consistency, and was formed of a mass of mycelium with numerous bacteria and other organisms. It was found that the substance developed at a point where the sewer was joined by a side-drain carrying a small amount of domestic sewage. In cultures the fungus grew very slowly unless a little nitrogen was added. It was proved to be an *Oidium*, but differed from any known species, especially in the leathery condition. It has affinities with *Oidium natalense*, a fungus isolated by Sir Aldo Castellani. It is strictly aerobic.

A. L. S.

Pulmonary Diseases Due to Fungi.—ALDO CASTELLANI ("Certain Bronchomycoses which may Simulate Pulmonary Tuberculosis," *Journ. Trop.*

Medicine & Hygiene, 1929, 1-14, 14 text-figs.). The fungi that have been found to cause pulmonary troubles are mainly yeasts with forms of *Oidium*, *Mucor*, *Aspergillus*, *Penicillium* and *Sporotrichum*. The cases in which these were found to be the causal agent of diseases are described, and in conclusion Castellani insists that more attention should be paid to such infections, which are not rare even in temperate climes, and, if early diagnosed, can be successfully dealt with. He considers the cases to be secondary bronchomycosis, and not to be confused with tuberculosis.

A. L. S.

Fungi in Milk.—H. A. CUMMINS, VIOLET C. E. KENNELLY, and M. GRIMES ("A Study of Fungi found in Milk," *Sci. Proc. Roy. Dublin Soc.*, 1929, 19, 511-17, 2 pls.). The examination of milk extended over the first five months of 1929. Extreme care was taken to avoid contamination, and the samples of milk were plated on nutrient lactose agar. Twenty-one species of fungi were determined, mostly varieties of moulds; the three most frequent were *Oidium lactis*, *Acrostalagmus cinnabarinus* and *Phoma* spp. Some species occurred very rarely. The large number of fungi is accounted for by the conditions under which the cows are housed and by improper cleansing of the dairy utensils.

A. L. S.

Serological Investigations.—G. K. K. LINK, A. E. EDGECOMBE, and J. GODKIN ("Further Agglutination Tests with Phytopathogenic Bacteria," *Bot. Gaz.*, 1929, 87, 531-47). The authors have investigated the question as to whether agglutination tests might be used in the identification and classification of bacterial plant pathogens. The work was correlated with that done by previous investigators, and a summary of all results is given. A number of bacteria were successfully differentiated by the authors by these tests, and in many cases affinities or lack of relationships were determined. The cereal bacterial pathogens were thus found to constitute a closely related group, with varying relationship to other bacteria. It has been finally proved that agglutination tests may be as successful and as useful in phytobacteriology as in other fields of bacteriological study. More detailed and penetrating work is, however, still required before reaching definite conclusions.

A. L. S.

Rot Disease of Carnation.—W. BUDDIN and E. M. WAKEFIELD ("The Fungus Causing the Leaf Rot of the Carnation," *Trans. Brit. Mycol. Soc.*, 1929, 14, 213-21, 3 text-figs.). The disease was discovered in this country in 1927, and is now evidently quite common. It forms greyish lesions on the leaves. The authors have made a cultural study of the fungus, both of the conidial and pycnidial stages, which have been identified separately as *Pseudodiscosia* sp. and *Heteropatella Dianthi*. The latter genus is the pycnidial stage of *Heterosphaeria*, the ascospore form, as yet unknown. The authors give full reasons for these determinations.

A. L. S.

Leaf-Spot Fungus.—A. K. BRIANT and E. B. MARTYN ("A Leaf-Spot of *Arctostaphylos menzani*," *Trans. Brit. Mycol. Soc.*, 1929, 14, 221-3, 2 text-figs.). The fungus, *Macrosporium sarcinula* Berk., induced brown spots on the leaves attacked. The fungal hyphae never penetrate below the epidermal cells, but some irritation or stimulation induces the formation of cork tissue in the cuticle and in the mesophyll. In cultures were developed the perithecia of *Pleospora herbarum*.

A. L. S.

Phytophthora on Cotton Seedlings.—M. MITRA ("Phytophthora parasitica Dast. causing 'Damping-off' Disease of Cotton Seedlings and Fruit Rot of Guava

in India," *Trans. Brit. Mycol. Soc.*, 1929, **14**, 249-60, 2 text-figs.). The fungus was found on the cotyledons and first formed leaves of cotton seedlings at Pusa, ultimately causing their death. Artificial cultures were made and inoculations from these were mainly successful, and proved that cotton plants could be attacked at different stages of growth. A fungus damaging guava fruits was found to be identical with the one on cotton. It is the only instance recorded of its presence on guava, though it has also been found growing on castor-oil plants. A. L. S.

Silver-Leaf Disease.—F. T. BROOKS and G. H. BRENCHELEY ("Injection Experiments on Plum Trees in Relation to *Stereum purpureum* and Silver-Leaf Disease," *New Phytologist*, 1929, **28**, 218-24). The injection experiments were made with a filtered non-living extract of *Stereum purpureum* with some of the culture fluid in which the fungus was grown, and also by using the culture fluid alone. In both instances silvering of the leaves resulted from the injections, along with browning of the flowers and leaf-tips. Browning of the wood in the vicinity of the injection holes also resulted, along with a gum-like formation. When the extracts were boiled, no silvering was formed, but other pathological symptoms, such as browning, were induced. The effect on the wood by these injections was exactly like that produced by the living fungus, *Stereum purpureum*. A. L. S.

Brown Rot Disease.—T. H. HARRISON ("Brown Rot of Fruits and Associated Diseases in Australia," *Journ. and Proc. Roy. Soc., N.S.W.*, 1929, **62**, 99-151, 5 pls.). The rotting disease of fruits was first noted by Persoon in 1796. It is very prevalent in Europe and in America, but was definitely found in Australia by McAlpine, who collected infected apricots near Melbourne, Victoria, in 1896. In 1917 fully 30 p.c. of the season's crop was destroyed by the fungus. The conidial stage, *Monilia cinerea*, is the stage of the disease best known. It forms dense minute tufts of hyphæ and conidia all over the fruits, with consequent rotting of the fruit itself. The apothecial stage, known as *Sclerotinia cinerea*, was not detected until 1921. The disease is located along the south-eastern seaboard of Victoria and New South Wales; it has not yet penetrated to South or West Australia. A description of various types of fruit attacked in the orchards is given—peaches and plums are most liable to infection. Many inoculations of the fungus and cultures of the spores were made, and the identity and life-history of the disease were fully established. A discussion follows as to the correct nomenclature, and the author has finally decided that the name *Sclerotinia fructicola* must stand. It is identical with the brown rot occurring also in New Zealand and in America. The organism causes, not only fruit rotting, but also twig blighting, blossom blighting and cankering, more particularly of stone fruits. A full list of the literature of the subject is added. A. L. S.

Parasitic Fungi.—R. TEHON and G. L. STOUT ("Notes on the Parasitic Fungi of Illinois—IV," *Mycologia*, 1929, **21**, 180-96). The specimens were obtained during a survey of plant diseases in Illinois. The forms all belong to the section of microfungi. A considerable number are new species. Three new genera were *Stigmatophragmia* (Hemisphæriaceæ), *Cyphellopynis* (Phomataceæ), and *Pseudodictya* (Leptostromataceæ). Many of the fungi are first records for Illinois. A. L. S.

Plant Diseases in Peru.—E. V. ABBOTT ("Diseases of Economic Plants in Peru," *Phytopathology*, 1929, **19**, 645-56). The diseases reported have been identified by the writer since his establishment at Lima in 1927. He has surveyed the territory under three geographical regions: the coast, the sierra, and the montaña.

Cotton and sugar-cane are the main export crops; coffee, rice, corn, potatoes, fruits and vegetables are grown for home consumption. Abbott takes each series of plants and gives the scientific and reference name of the disease, with the time of appearance and its importance to the grower. The diseases are almost all due to microscopic fungi. In all he has listed 106 diseases, of which 95 are due to fungus attacks; five are of virus origin, and five are physiological or are caused by nematodes. A. L. S.

Congo Parasites.—E. MARCHAL and H. L. STEYAERT ("Contribution à l'étude des champignons parasites des plantes au Congo belge," *Bull. Soc. Roy. Bot. Belgique*, 1929, 61, 160–9, 4 pls.). The infected plants were collected in the Congo and sent to Belgium to be examined and determined. The result shows a wide range of plants attacked and also of parasites. They occur mostly on leaves, though a few are corticolous. The authors note that *Puccinia graminis* and *P. triticea*, as in other hot climates, propagate without the æcidial stage. No specimens of *Berberis* nor of *Thalictrum*, the alternate hosts, have been found in the Eastern Congo. The uredine parasite *Darluca filum* was so abundant on the uredosori that no further spore stage could develop. Teleutospores were scarcely to be found. Very many of the parasites are new to science, and these have been diagnosed and described, and reproduced on the photographic plates. A. L. S.

Note on Glomerella.—J. DUFRENOY ("Récent travaux relatifs au *Glomerella cingulata* (Stonem) Spaulding et von Schr. et à sa forme conidienne: *Colletotrichum gloeosporoides*," *Ann. Crypt. exot.*, 1929, 2, 82–4, 1 text-fig.). The author has given a summary of results concerning the history of *Glomerella cingulata*, the conidial form of which is *Colletotrichum gloeosporoides*. It occurs all over the world on *Citrus* leaves—not normally a parasite, but found to penetrate tissues weakened by frost, and thus give rise to anthracnose. It has also been found in the branches of a *Citrus*, the leaves of which were seen to be decaying. A. L. S.

Citrus Disease in Florida.—J. DUFRENOY ("Trois maladies des Citrus de Floride," *Tom. cit.*, 79–81, 1 text-fig.). These diseases are known as (1) *Psorosis*, some unknown mycelium giving rise to gummoses of the stems; (2) *Leprosis*, or "nail-head rust," due to *Cladosporium herbarum* and widespread throughout the world, though not common; and (3) *Scab*, due to *Cladosporium Citri*, which attacks orange and grape-fruit trees. These are all recent arrivals in Florida. A. L. S.

Pink-Root Disease.—H. N. HANSEN ("Etiology of the Pink-Root Disease of Onions," *Phytopathology*, 1929, 19, 691–704, 5 text-figs.). Hansen has investigated the cause of the disease. The affected roots are characteristically pink. This colouration betrays the presence of the disease, but at a later stage those affected lose their turgidity and assume a water-soaked appearance. Taubenhaus, who first noted the disease in 1917, considered that it might be due to a *Fusarium*. Hansen has taken up the subject, and by means of many inoculations, culture studies, and microscopic observations, he has found that the causal agent is a *Phoma* fungus. It was evident, however, that species of *Fusarium* acted as secondary parasites and hastened the destruction of the host. Hansen considers that he is dealing with a new fungus, which he names and describes as *Phoma terrestris*. It is not confined to the genus *Allium*, but attacks other plants—cowpea, lima bean, potato, etc. A. L. S.

Black Mould of Onions.—J. E. MACHACEE ("The Black Mold of Onions, caused by *Aspergillus niger* V. Tiegh.," *Phytopathology*, 1929, 19, 723–39, 4 text-figs.).

The mould was discovered in great abundance on imported Spanish onions, and reduced considerably their market value. The fungus was easily identified, and is well known as a weak parasite. Examination showed a rot accompanying the black mould caused by a bacterium, *Erwinia carotovora*. It was found that after the death of the tops the *Aspergillus* settled on the dead tissues and penetrated slowly into the interior, causing a mild rot. It was often accompanied or followed by the bacterium, which caused a more destructive and extensive rot of the tissues. Generally the bulbs are discoloured on the surface, but sometimes the whole damage is internal and not easily detected. The author recommends seed and sets disinfection to prevent infection in the field, but after-care of the bulbs at the time of harvesting, packing, etc., is essential. A. L. S.

Leaf-Spot of Sycamore.—C. A. APOSTOLIDES ("A Leaf-Spot of Sycamore caused by *Stigmata Platani* (Fuck.) Sacc.," *Phytopathology*, 1929, 19, 667-71, 2 text-figs.). The fungus causing spot and fall of the leaves of *Platanus racemosa* was studied by the writer and finally diagnosed as due to *Stigmata Platani*. The spots are scattered over the lower surface, and in a bad infection the whole lower surface is blackened and the epidermis is loosened by the fungus. Experiments by surface and puncture inoculations were made with successful results. The fungus belongs to the Hyphomycetes, with dark septate conidia produced in masses. A. L. S.

Onion Virus Disease.—T. E. MELHUS, C. S. REDDY, W. J. HENDERSON and EDGAR VESTAL ("A New Virus Disease Epidemic on Onions," *Phytopathology*, 1929, 19, 73-7, 1 text-fig.). The disease appeared in epidemic form in the Iowa onion district in 1928, although it had been observed before. In advanced cases the plants are severely stunted and yellow, suggesting a wilt disease. Marked stunting occurred on all diseased plants. Plants grown from seed were freer from the disease, which was most virulent on those grown from sets or mother bulbs. As no parasitic organism could be found, it was concluded that the injury was due to a virus. Material for inoculation of healthy plants was prepared from the diseased plants, and the disease was transmitted by the inoculum. The writers warn onion growers to choose their sets carefully, and plant only those that are warranted free from disease. A. L. S.

Lichens.

Lichens of Ireland.—MATILDA C. KNOWLES (*Proc. Roy. Irish Acad.*, 1929, 38, sect. B., no. 12, 179-434). M. Knowles has given the results of many years' labour, and has recorded, not only her own and other collections, but all information dating from the earliest times concerning Irish lichens. The work is divided into four parts: Introduction, Bibliography, Systematy and Index of Genera. The first mention of lichens in Ireland was by Caleb Threlkeld (1676-1728), who, in the *Synopsis Stirpium Hibernicarum*, lists five species—one under *Lichen*, two under *Muscus*, and two under *Lichenoides*. The first important systematic work was Mackay's "Flora Hibernica" (1836), which included about 400 lichen species. Much work was done by zealous botanists in the following years, all leading up to this comprehensive account of Ireland's lichen flora. The country has been divided into 40 topographical divisions, and a number of botanists took part in the survey, every plant being tested or determined by M. Knowles herself. The number of species recorded from Great Britain up to 1926 was 1245. Of these, 990 were recorded from England and Wales, and 802 for Ireland. Since that date 163 species have been added to the Irish flora, seven of which were new to science. A considerable number are found in Ireland and not in Great Britain. Alpine species are rare,

while subalpine are abundant, and a number of tropical or subtropical species grow in the south-western counties. In the systematic portion the "Monographs of Lichens," published by the British Museum, have been followed in the arrangement and nomenclature. Names of localities and of collectors are given, as well as the topographical divisions, these last being the geographical arrangement of Dr. Praeger's "Irish Topographical Botany." Careful attention has also been given to the substratum and to the frequency of occurrence. The work is not meant to be final, but to provide a starting-point for further exploration, as well as a record of what has been already achieved.

A. L. S.

Oxford Lichens.—R. PAULSON ("Lichens of the Oxford Foray," *Trans. Brit. Mycol. Soc.*, 1929, **14**, 183-5). It was found that the lichens in Bagley Wood, which occupies a height up to 370 feet, were well developed. Specimens were also secured from the walls outside and inside the city. A list with localities is appended.

A. L. S.

Sussex Lichens.—H. H. KNIGHT (*Tom. cit.*, 191-3). The lichens were collected during the autumn foray (1928) in the neighbourhood of Littlehampton. Many interesting species were found, and mostly in good fruiting conditions; the previous dry weather had evidently produced no ill effect on the plants. Graphidaceæ were well represented.

A. L. S.

Text-book of Larger Lichens.—J. ANDERS ("Die Strauch- und Laubflechten Mitteleuropas. Anleitung zum Bestimmen der in Mitteleuropa vorkommenden Strauch- und Laubflechten," Gust Fischer (1928), 1-217, 30 pls., 8 text-figs. See *Hedwigia*, 1928, **68**, Beibl., 69-70). Anders has provided a guide to the larger lichens of Central Europe. These include Parmeliaceæ, Usneaceæ, Physciaceæ, Cladoniaceæ, etc. Descriptions of species and varieties are given, with keys to assist in their identification. An account of the lichen thallus is also added, with information as to collecting and preserving the plants.

A. L. S.

Cetraria islandica in Belgium.—LOUIS GILTAY ("Notes lichénologiques," *Bull. Soc. Bot. Belgique*, 1929, **61**, 120-2). Notes on different varieties and forms that have been found in Belgium. The locality explored was generally "heather moorland." The writer concludes that it represents not a glacial remnant, as has been supposed, but plants native to the districts where they occur—usually on siliceous soil.

A. L. S.

Lichens of Blakeney Point.—P. W. RICHARDS ("Notes on the Ecology of the Bryophytes and Lichens at Blakeney Point, Norfolk," *Journ. Ecol.*, 1929, **17**, 127-40). Only a small part of the paper is concerned with the lichens of the district. A general topographical account is given of the dunes, which form three ridges on the shore, one behind the other. In time the lichens increased in species and individuals more than did the moss flora. Among the most abundant were species of *Cladonia*. A contrast is drawn between these dunes and those of the West Coast, where there were fewer *Cladoniae*, the difference of the vegetation being due to the presence or absence of lime.

A. L. S.

American Lichens.—A. H. MAGNUSSON ("The Yellow Species of *Acarospora* in North America," *Mycologia*, 1929, **21**, 249-60). Magnusson has given a key to all the species found in the States and in Mexico. These number 16, and the list includes 8 new species described by himself. One of these, *Acarospora samoensis*, is from the Hawaiian Islands. Emphasis in determining species is given to the height of the hymenium.

A. L. S.

Scandinavian Lichens.—A. H. MAGNUSSON ("Flora över Skandinavien Busk- och Bladlavar utarbetad huvudsakligen för Nybörjare," Stockholm, Norstedt & Sömers, 1929, 1–127, 6 pls., 11 text-figs.). In this work Magnusson begins with a clear account of the structure and development of lichens in general. In the systematic portion he has dealt only with the larger fruticose and foliose forms, an arrangement that breaks up families such as Dermatocarpaceæ and Sphærophoraceæ. The book is abundantly supplied with keys to genera and species, and these are described shortly, but with the determining characters emphasised. A glossary of terms is provided. The photographic plates give a fine representation of the genera and of many species.

A. L. S.

Lichens of the Erzgebirge.—H. LANGE ("Zur Flechtenflora des Erzgebirges das obere Zschopaugebiet," *Hedwigia*, 1929, 69, 56–83). The district examined lies in Saxony and partly in Bohemia. The highest hills of the district are the Saxon Fichtelberg (1214 m.) and the Bohemian Keilberg (1244 m.). The river valleys are those of Mittweida and the Heidelbaches. Geologically the most important rocks are the gneiss and schists of Annaberg and Marienberg. Archaic rocks (basalt) are also present, though the flora on these differs from place to place owing to differing orientation. Limestone rocks were at one time abundant, but the flora on these has suffered from repeated blasting operations. There are few exposed rocks in the district, but on these there may be found a massive growth of certain species. As to development, *Parmelia conspersa* fruited well on large stones. High exposed mountain slopes that showed few signs of weathering were covered with crustaceous lichens. Corticolous lichens had suffered most in the time changes, as may be judged from comparison with earlier literature. Pine forests have taken the place of the older mixed woods; beech has almost disappeared, and the forests are cleared from fallen trees and stumps. On the open roads the tree stems have been whitewashed for the sake of motorists, thus killing off epiphytic vegetation. The smaller valleys have generally remained unchanged, but the lichen flora has suffered from the increasing shade of advancing woodland. In the floristic portion of the paper full details of locality and substratum are given, with occasional biological notes. *Peltigera spuria* was watched at a definite area, and found to be continually increasing for a time till fructification reached its height in the third year. In the fourth year the lichen had disappeared. *Peltigera polydactyla* grew abundantly on a limestone rock, a sterile plant of 18 cm. in width. A fourth part was cut away in 1923; three years later the empty space was entirely regrown with the lichen. *Cetraria islandica* was abundant over the whole region; in several instances there were large numbers of the lichen heavily sorediate on the upper surfaces of the fronds—an unusual condition for that lichen. A number of species are new to Saxony. One new species, *Lecanora microcarpa*, is described by E. Bachmann.

A. L. S.

Lichens of Jugoslavia.—M. SERVIT ("Flechten aus Jugoslawien," *Hedwigia*, 1929, 69, 1–38, 2 text-figs.). Servit has selected for exploration the Velebitgebirge, which rises from the Dalmatian coast to a height of 1610 m., opposite the Island of Arbe. He describes the locality as peculiarly favourable for lichen growth, owing to an abundance both of sunlight and moisture, with proximity to the sea, while on the heights there occur valleys and forests rich in lichens. He has divided the region from the sea inwards into fifteen distinct localities, describing each in turn as to height, orientation and substratum, and has given a record of the characteristic lichens for each. There follows a list of all the plants in systematic order. Many biological and descriptive notes are given, with exact microscopic measure-

ments. Several new species described by Zahlbruckner are included, along with a number of forms by the author. A. L. S.

Morphology of Cladonia.—M. CHOISY ("La morphologie du genre *Cladonia*, Lichen Discomycète," *Bull. Soc. Mycol. France*, 1929, **45**, 184–8). Choisy has again challenged the Moreaus on the correctness of their views as to the origin of the *Cladonia* podetium. They hold that it arises as do the soredia (soredial papillæ). Choisy goes back to the primordium of the soredium as outlined by the authors, who had stated that soredia arose through the gonidial activity bursting the cortex, while the podetium developed from the cortical tissues. Choisy points out that the gonidia are active members in the centre of the soredium, while in the podetium they occupy the outside, like the apothecial margin of a *Lecanora*, and also that the gonidial layer of the thallus is interrupted by the emergence of the podetium, but not on the formation of soredia. Choisy therefore affirms that the podetia are apothecial stalks, an integral part of the apothecium, but not the apothecium itself. He cites Werner's results on the growth of *Cladonia squamosa* hyphæ in culture, which developed an unmistakable podetium at the end of five months. A. L. S.

New Spore Characters.—M. CHOISY ("Existe-t-il un nouveau type de spores en Mycologie," *Bull. Soc. Roy. Bot. Belgique*, 1928, **61**, 71–4). Choisy draws attention to the somewhat peculiar types of spores that are to be found in the lichen genera *Pertusaria*, *Ochrolechia*, etc. In all the cases cited he is dealing with a very large type of lichen spore. By careful staining he has demonstrated in each spore a large number of nuclei. Each nucleus is surrounded by cytoplasm. He has come to the conclusion that *Ochrolechia* has more affinity with *Pertusaria* than with *Lecanora*; he also suggests that the multinucleate spore may be a derivative of the muriform spore—a matter of phylogenetic interest. A. L. S.

Mycetozoa.

Study of Didymium.—DOROTHY M. CAYLEY ("Some Observations on Mycetozoa of the genus *Didymium*," *Trans. Brit. Mycol. Soc.*, 1929, **14**, 227–48, 2 pls., 3 text-figs.). A suitable medium on which to grow *Didymium* was found in Knop agar, and as it is slightly acid, the production of bacteria is partly inhibited. Notes are given on the influence in cultures—detrimental or otherwise—of bacterial species of *Penicillium* and yeasts, the latter detrimental at any stage. The amount of moisture present also influences the culture, giving rise to morphological changes such as the formation of sessile or stalked forms. Moisture was essential for fusion in *Didymium difforme*, as that takes place only between motile gametes. After fusion the zygotes either round themselves off (in dry conditions) or become amoeboid. The amoebæ appear to coalesce, but retain their individuality and may separate. Plasmodia may arise from a single zygote. The duration of the plasmodium varies with different species and with different conditions. Skupienski had stated that the spores of *D. difforme* were not only haploid, but monosexual, but Cayley induced the formation of plasmodiocarps in three generations of monospore cultures. Fusion of motile swarm-spores was observed in a monospore culture, and the development of the monospore culture did not differ from a control multispore culture. A detailed account of the fusion process between motile spores is given. The writer has deduced from her experiments and observations that the spores of *D. difforme* are bisexual, and that sex segregation must occur at some division after the germination of the spore. A. L. S.

New Species of Mycetozoa.—G. LISTER ("A New Species of *Hemitrichia* from Japan," *Trans. Brit. Mycol. Soc.*, 1929, 14, 225-7, 1 pl.). Specimens of two Mycetozoa collected by the Emperor of Japan in the palace grounds were sent to G. Lister, accompanied by photo-micrographs. One of the species, *Physarella oblonga*, had not previously been reported from Japan; the other is a new species of *Hemitrichia*, tawny-yellow in colour, finally named *H. imperialis* in honour of the distinguished collector, who is an interested student of the Mycetozoa. Dr. Hattori, who sent the specimens, had succeeded in growing the new species from spores in the laboratory, and obtained sporangia. The original specimen grew on wood. A. L. S.

American Mycetozoa.—ROBERT HAGELSTEIN ("New Mycetozoa from Long Island," *Mycologia*, 1929, 21, 297-9, 1 pl.). Hagelstein describes the locality as covered with moraine and glacial *débris* left by the last ice sheet, and the numerous kettle holes, swamps, and wooded areas afford excellent collecting grounds, rich in many species. He has discovered two new species, both on dead leaves and in the same kettle hole. The first species, *Comatricha Rispaudii*, is distinguished by the solid columellæ and by the beautifully reticulated spores. The other species, *Cribraria laxa*, was collected several years in succession, the specimens all constant in characters and habitat. The sporangia grew on leaves, but the plasmodium on the ground, an unusual habitat. There has also been found a new variety, *Arcyria insignis* var. *dispersa*, in which the sporangia were scattered. A. L. S.

Myxomycetes of Western Washington.—H. C. GREENE (*Mycologia*, 1929, 21, 261-73.) The author gives a short account of Mycetozoa, their life-history and occurrence. He then proceeds to list those found for the region—141 forms belonging to 34 genera. He frequently adds biological notes, especially of unusual species. Several are new to America. He considers that the list might be considerably enlarged by further search in a more favourable season. A. L. S.

Morphogenesis in Polysphondylium.—R. A. HARPER (*Bull. Torr. Bot. Club*, 1929, 56, 227-58, 5 pls.). The theme of the paper is the morphology and development of the stipe, branches, etc., of the Acrasie, more especially of *Polysphondylium*, which is distinguished by many whorls of branches on the long stipe. The organism, *P. violaceum*, was cultivated on highly nutritious dung agar. The amœbæ become very numerous within the first 24 hours, and form dense strands converging to the future base of the sorophore, which is gradually built up by the amœbæ on the basal pseudoplasmodium. Branching begins when the stipe has reached considerable height, the branches arising from thick ring-like clusters of myxamœbæ successively formed on the stipe. The branch is a lateral element attached by slime to the main axis just as the main stipe is attached to the substratum. The amœbæ meanwhile by form changes have built up in the stipe a dense parenchyma-like structure, the amœboid cells increasing in size mainly by vacuolisation. All the different stages have been carefully noted and described. A. L. S.

TECHNICAL MICROSCOPY.

Histological Structure of Skin and its Relation to the Quality of the Finished Leather.—M. KAYE (*J. Int. Soc. Leather Trades Chem.*, 1929, 13, 73-87, 118-54). This paper is divided into two parts, the first dealing with the histological structure of the skin, and the second part with the relation of the structure and

arrangement of the fibres to the quality of the finished leather under the following headings: (1) The conditions of the fibre structure which affect the finished leather; (2) the probable causes of the condition and arrangement of the fibres in the finished leather; (3) the significance of the fibre condition throughout the wet-work and tanning; (4) methods of preparation and examination of material. The paper is illustrated by 47 photomicrographs. A. H.

A Study of the Microscopical Structure of Some Fish Skins.—M. KAYE (*J. Int. Soc. Leather Trades Chem.*, 1929, 13, 515-22). Fish skins appear to have no fat glands, while, as distinct from mammalian skins, the fibres are horizontal, with occasional vertical columns of fibres. This peculiar arrangement may be the cause of lack of suppleness and stretch in the finished leather. The sections of dogfish, ray and cod show an epidermis and low dermal layer divided into the grain and corium. Other physiological features are described (with five figures). Elastin fibres are present, but there are very few in the cod skin. A. H.

NOTICES OF NEW BOOKS.

The Kinematical Design of Couplings in Instrument Mechanisms.—By A. F. C. POLLARD. 1929. 64 pp., 25 text-figs. Published by Adam Hilger, Ltd., 24, Rochester Place, Camden Road, London, N.W.1. Price 4s. 6d. net.

Sedimentary Petrography.—2nd Edition. By HENRY B. MILNER. 1929. xxii, 514 pp., 181 figs. Published by Thomas Murby & Co., 1 Fleet Lane, London, E.C. 4. Price 21s.

Grosse Männer Studien zur Biologie des Genies.—Vol. 10.—Joseph Fraunhofers Leben, Leistungen und Wirksamkeit. By MORITZ v. ROHR. 1929. xx, 233 pp., 1 plate, 39 text-figs. Published by Akademische Verlagsgesellschaft m. b. H., Leipzig.

Crystal Structure and Chemical Constitution.—A General Discussion held by the Faraday Society, March, 1929. 170 pp., 6 plates, 55 text-figs. Published by the Faraday Society, 13, South Square, Gray's Inn, London, W.C. 1. Price 8s. 6d. net.

Atmospheric Corrosion of Metals.—Third (Experimental) Report to the Atmospheric Corrosion Research Committee (British Non-Ferrous Metals Research Association). A Discussion held by the Faraday Society, May, 1929. 104 pp., 5 plates, 41 text-figs. Published by the Faraday Society, 13, South Square, Gray's Inn, London, W.C. 1. Price 5s. 6d. net.

Biological Stains.—A Handbook on the Nature and Uses of the Dyes Employed in the Biological Laboratory. 2nd Edition. By H. J. CONN. 1929. 224 pp., 5 text-figs. Published by the Commission on Standardization of Biological Stains, Geneva, N.Y., U.S.A. Price \$3.00.

Diatomite : Its Occurrence, Preparation, and Uses.—By V. L. EARDLEY-WILMOT. 1928. viii., 182 pp., 15 plates, 31 text-figs. Published by the Department of Mines, Canada. Price 30 cents.

Catalogue of the Printed Books and Pamphlets in the Library of the Royal Microscopical Society. 1929. vii, 177 pp. Published by the Royal Microscopical Society, 20, Hanover Square, London, W.1. Price 3s. 6d. Price to Fellows, 2s. 6d. Postage 3d.

Zoologisch-mikroskopische Methodik mit Einschluss der embryologischen Technik.—By W. A. COLLIER. 1929. 463 pp. Published by Urban & Schwarzenberg, Friedrichstrasse 105 B, Berlin, N. 24. Price 24 marks.

In this section of Abderhalden's *Handbuch der biologischen Arbeitsmethoden* Dr. W. A. Collier, of Berlin, deals in an exhaustive manner with the methods which have been found most suitable for the fixation and staining of all forms of zoological material. The various modifications of physiological saline suitable for vertebrates and invertebrates are clearly set out, and in addition there is an interesting table giving the best methods of anæsthetising all classes of animals. Fixing and staining solutions are dealt with on more or less classical lines, but a useful feature is a classification of the dyestuffs commonly used in biology, with their structural formulæ and a complete list of the staining solutions into which they enter (pp. 1648–1694). The volume is provided with a good index and is so arranged that it is an easy task to find the information required—a somewhat striking contrast to certain handbooks of histological technique published in the English language. G. M. F.

Notes on Diatoms.—An Introduction to the Study of the Diatomaceæ. Compiled by F. B. TAYLOR, B.A. 1929. 269 pp., 5 plates. Published by F. B. Taylor, B.A., 2A, Montague Road, Bournemouth. Price 21s., or \$5.00.

This "modest harvest of a long labour of love" is a notable contribution to diatom literature. The author has brought within the compass of the volume a mass of useful information which otherwise could only be gathered together by a vast expenditure of time and searching, even if one had access to a complete diatom library—and how many diatomists have that? The chapters on Growth, Structure, Reproduction and Collection of diatoms are full of interesting and valuable information, and there is a comprehensive account of the various attempts at classification from the first illustration of a diatom in 1703 to the present time. A very helpful chapter on Nomenclature gives (*inter alia*) the rules of the Botanical Congress relating to diatoms, and a glossary showing the derivation of all generic names. The section on the Literature of Diatoms is treated chronologically, and omits nothing of importance. The identification of diatoms is difficult, as anyone who has often had to search through the 368 plates of Schmidt's Atlas and other collections of figures will admit, but workers will find considerable help here in a complete list of Genera, admitted and obsolete, which, in conjunction with a very full list of illustrations, constitutes a practical labour-saving index to the principal works on the subject. An excellent appendix gives references to authorities quoted in the work, so that further research may be facilitated. The up-to-date character of the work is evidenced by the account (p. 122) of Merlin's announcement in 1928 of his discovery that ciliary action is undoubtedly the propelling force of all actively-moving diatom frustules. "Notes on Diatoms" should certainly be on the shelves of every serious student of the Diatomaceæ. J. A. L.

PROCEEDINGS OF THE SOCIETY.

AN ORDINARY MEETING

OF THE SOCIETY WAS HELD AT 20 HANOVER SQUARE, LONDON, W.1, ON WEDNESDAY, OCTOBER 16TH, 1929, MR. JOSEPH E. BARNARD, F.R.S., PRESIDENT, IN THE CHAIR.

The Minutes of the preceding Meeting were read, confirmed, and signed by the President.

New Fellow.—The following candidate was balloted for and duly elected an Ordinary Fellow of the Society :—

Dr. Francisco Medina, Mexico.

Nomination Certificates in favour of the following candidates were read for the first time, and ordered to be suspended in the Rooms of the Society in the usual manner :—

As Ordinary Fellows of the Society :—

Sydney Bennett Fulford, Fulham.
 Alfred F. Fullard, Canterbury, Australia.
 Carl R. Hiller, M.D., Cincinnati.
 Herbert Lloyd Hind, London.
 George P. Matthews, Boston.
 Andrew More, A.R.C.S., Walton-on-Thames.
 H. R. Rivers-Cole, L.D.S., R.C.S.Eng., Barkingside.
 Heinz Rosenberger, New York.
 R. A. Sheldrake, Newark-on-Trent.
 H. Siedentopf, Jena.
 Robert Walton, F.C.S., Alexandria.
 Morris N. Watt, M.B., Ch.B., Dunedin.
 Allan J. Way, Sydney.
 J. D. S. Wood, Steyning.

As Honorary Fellows :—

Frederick Chapman, A.L.S., F.G.S., Melbourne.
 Professor Hans de Winiwarter, Liège.

Donations received during the Vacation were reported from :—

M. Paul Lechevalier—

“Faune de France. Vol. 20—Coléoptères.” By F. Picard.

Trustees of the British Museum—

“Catalogue of Madreporarian Corals. Vol. vii—A Monograph of Recent Meandroid Astræidæ.” By George Matthai.

Herren Urban & Schwarzenberg—

“Zoologisch-mikroskopische Methodik mit Einschluss der embryologischen Technik.” By W. A. Collier.

Messrs. Gurney & Jackson—

“Crystal Structure and Chemical Constitution.” A General Discussion held by the Faraday Society, March, 1929.

Messrs. Thomas Murby & Co.—

“Sedimentary Petrography.” 2nd edition. By H. B. Milner.

Professor Dr. Moritz v. Rohr—

“Joseph Fraunhofers Leben, Leistungen und Wirksamkeit.” By M. v. Rohr.

Mr. F. B. Taylor, B.A.—

“Notes on Diatoms.” By F. B. Taylor.

Mr. J. G. Bradbury, F.R.M.S.—

Fifteen shillings.

Dr. R. Howard Mole, B.A., M.D. —

Ten pounds.

Mr. Arthur Earland, F.R.M.S.—

A collection of sixty-one slides of Foraminifera.

Professor Dr. L. S. Ornstein (per Dr. P. H. van Cittert), Utrecht—

A copy of one of Leeuwenhoek's microscopes.

Major W. F. Dixon-Nuttall, D.S.O.—

Swift Challenge binocular microscope in case, with accessories.

Smith and Beck binocular microscope in case, with accessories.

Two small microscopes and telescope in case.

One dissecting microscope.

A collection of micro slides.

Twenty volumes and a collection of pamphlets and drawings, chiefly Rotifera.

Votes of thanks were accorded to the donors.

The Deaths were reported of :—

Sir E. Ray Lankester. Elected 1865. Hon. Fellow 1928.

John M. Lones. „ 1925.

Mark L. Sykes. „ 1889.

The Fellows expressed their condolence with the relatives by standing in silence.

Paper.—The following communication was read in title :—

Mr. Tamaki Shimamura—

“ Meiosis in *Rumex pulcher* L.”

THE ANNUAL POND LIFE AND GENERAL MICROSCOPICAL EXHIBITION.

The following objects were exhibited by Fellows of the Society and Members of the Quekett Microscopical Club :—

Mr. S. E. Atwell, F.R.M.S.	.. ..	<i>Adineta</i> sp.
Mr. W. E. Watson Baker, F.R.M.S.	.. ..	<i>Stephanoceros eichhorni</i> .
Mr. J. E. Barnard, F.R.S., P.R.M.S.	.. ..	Ultra-violet photomicrographs.
Mr. A. J. Bowtell, F.R.M.S.	.. ..	<i>Batrachospermum</i> .
Mr. N. E. Brown	.. ..	<i>Didinium nasutum</i> feeding on <i>Paramecium</i> .
Mr. D. Bryce, F.R.M.S.	.. ..	<i>Philodina nemoralis</i> from a roof-gutter.
Mr. C. Campbell	.. ..	<i>Anoplophrya clavata</i> Leidy.
Dr. J. D. Coales, F.R.M.S.	.. ..	<i>Hydra viridis</i> .
Prof. R. Ruggles Gates, F.R.M.S.	.. ..	<i>Aponogeton angustifolium</i> , <i>A. distachyum</i> , <i>Wolffia arrhiza</i> , <i>Isoetes capensis</i> , <i>Hydrodictyon africanum</i> and <i>H. indicum</i> , all from vleis (ponds) on the Cape Flats near Cape Town; also <i>Nostoc</i> sp. and <i>Sirogonium sticticum</i> from Victoria Falls.
Mr. C. E. Heath, F.R.M.S.	.. ..	<i>Melicerta ringens</i> .
Capt. W. S. Hoseason, F.R.M.S.	.. ..	<i>Cercariae</i> (<i>Xiphidio</i> , <i>Furcocerus</i>).
Mr. H. E. Hurrell, F.R.M.S.	.. ..	<i>Lophopus crystallinus</i> ; also <i>Fredericella sultana</i> .
Mr. J. J. Jackson, F.R.M.S.	.. ..	<i>Gammarus pulex</i> .
Mr. A. Morley Jones	.. ..	<i>Prestwichia aquatica</i> ♂ and ♀.
Mr. H. J. Lawrence	.. ..	<i>Hydrodictyon reticulatum</i> —an abnormal form grown in a Petri dish—also <i>Arrhenurus tricuspidatus</i> .
Dr. R. J. Ludford, F.R.M.S.	.. ..	Free Nerve-endings in Epidermis; also Mitochondria in Kidney, and relation of Nerve Fibres to Normal and Malignant Epithelium.
Mr. E. G. Miller, F.R.M.S.	.. ..	<i>Puccinia graminis</i> on Mint.
Dr. J. A. Murray, F.R.S., F.R.M.S.	.. ..	A pond leech, <i>Clepsine</i> sp., with young.
Mr. C. H. Oakden, F.R.M.S.	.. ..	Water-mite <i>Brachypoda versicolor</i> .
Mr. J. Richardson, F.R.M.S.	.. ..	Diatoms (<i>Epithemia</i>) on filaments of <i>Cladophora</i> .
Mr. D. J. Scourfield, F.R.M.S.	.. ..	<i>Daphnia pulex</i> with ephippium; also <i>Chromatium Okenii</i> and <i>Thiospirillum jenense</i> , two of the sulphur bacteria.
Mr. R. S. W. Sears, F.R.M.S.	.. ..	<i>Oscillatoria</i> sp. and <i>Cosmarium</i> sp.
Mr. C. D. Soar, F.R.M.S.	.. ..	Water-mite <i>Arrhenurus securiformis</i> ♂.
Mr. W. R. Traviss	.. ..	<i>Limnias ceratophylli</i> .
Mr. H. Taverner, F.R.M.S.	.. ..	Stereo-photographs in natural colour.

On the invitation of the President, Mr. D. J. Scourfield briefly described the Pond Life exhibits, and in the course of his remarks drew attention to one or two gaps in the exhibition, notably that neither Flagellates nor Ciliates were represented.

Dr. R. J. Ludford, at the President's request, described his exhibit of free nerve-ending cells in Epidermis, and the relation of nerve fibres to normal and malignant Epithelium. He also called attention to a beautiful series of photomicrographs taken in ultra-violet light, exhibited by the President, and to a series of stereophotographs in natural colour exhibited by Mr. Taverner.

On the motion of the President, a hearty vote of thanks was accorded to the Members of the Quekett Microscopical Club and to the Fellows of the Society who had contributed to the success of the evening by bringing exhibits, and to Mr. Scourfield and Dr. Ludford for their remarks. A vote of thanks was also accorded to Messrs. E. Leitz for the loan of microscopes.

The President announced that the Biological Section would meet in the Library on Wednesday, November 6th, 1929.

The business proceedings being terminated, the Meeting then resolved into a conversazione.

AN ORDINARY MEETING

OF THE SOCIETY WAS HELD AT 20 HANOVER SQUARE, LONDON, W. 1, ON WEDNESDAY, NOVEMBER 20TH, 1929, MR. JOSEPH E. BARNARD, F.R.S., PRESIDENT, IN THE CHAIR.

The Minutes of the preceding Meeting were read, confirmed, and signed by the President.

New Fellows.—The following candidates were balloted for and duly elected—
Ordinary Fellows of the Society :—

Sydney Bennett Fulford, Fulham.
Alfred F. Fullard, Canterbury, Australia.
Carl R. Hiller, M.D., Cincinnati.
Herbert Lloyd Hind, London.
George P. Matthews, Boston.
Andrew More, A.R.C.S., Walton-on-Thames.
H. R. Rivers-Cole, L.D.S., R.C.S.Eng., Barkingside.
Heinz Rosenberger, New York.
R. A. Sheldrake, Newark-on-Trent.
H. Siedentopf, Jena.
Robert Walton, F.C.S., Alexandria.
Morris N. Watt, M.B., Ch.B., Dunedin.
Allan J. Way, Sydney.
J. D. S. Wood, Steyning.

As Honorary Fellows :—

Frederick Chapman, A.L.S., F.G.S., Melbourne.
Professor Hans de Winiwarter, Liège.

The Nomination Certificates in favour of the following candidates were read for the first time, and ordered to be suspended in the Rooms of the Society in the usual manner :—

Thomas Charles Ashby, Tonbridge.
A. Luces, Eastbourne.
James William Smart, London.

Donations were reported from :—

Canadian Government (Department of Mines)—

“Diatomite: its Occurrence, Preparation and Uses.” By V. L. Eardley-Wilmot.

The Faraday Society—

Report of Discussion on “The Atmospheric Corrosion of Metals.”

Mr. H. J. Conn—

“Biological Stains.” By H. J. Conn.

Microscopes Nacet (Société Anonyme, Paris)—

“Collection Nacet. Instruments scientifiques et livres anciens.”

The Royal Society—

One hundred pounds.

Mr. E. Heron-Allen, F.R.S., and Mr. Arthur Earland, F.R.M.S.—

Seven paratype slides of Foraminifera from the South Atlantic.

Votes of thanks were accorded to the donors.

Papers.—The following communications were read and discussed :—

Dr. P. de Beauchamp, D.Sc.—

“*Dicranophorus hudsoni* (Glascott).” (Communicated by Mr. David Bryce, F.R.M.S.)

Dr. J. A. Hewitt, D.Sc., Ph.D., A.I.C. —

“Sarcocystis in Human Heart Muscle.”

Mr. T. E. Wallis, B.Sc., F.I.C., F.R.M.S.—

“The Projectograph. An Optical Instrument for the Projection of Images of Microscopical Objects.”

The following communications were read in title :—

Parimal Bikas Sen, M.Sc.—

“Fixing Action of Certain Chemical Reagents in Dehydrated Condition and their Mechanism.”

Robert Burgess, M.Sc., and Claude Rimington, M.A., Ph.D.—

“A Technique for the Microscopical Examination of Wool Fibres.”

Professor J. Brontë Gatenby, B.A., D.Phil., D.Sc., F.R.M.S., and Miss F. D. King—

“Note on the Nutrient Membrane of *Grantia amphiblastula*.”

Professor H. F. W. Siedentopf—

“On the Theory of the Reflecting Condenser for Dark-Field Illumination.”

Votes of thanks were accorded to the authors of the foregoing communications and to Messrs. E. Leitz for the loan of microscopes.

The President announced that the Biological Section would meet in the Library on Wednesday, December 4th, 1929.

The business proceedings then terminated.

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